Project Manual for

Spadina Museum
Garage Rehabilitation and Site Accessibility
285 Spadina Road, Toronto, ON

Credit: Stevens Burgess Architects

SBA Project No.: A22048

Issued for Retender and Permit Application

Oct. 20. 2023

Company (Author) Abbreviations:
Stevens Burgess Architects Ltd. – SBA
Tacoma Engineers Inc. – Tacoma
Mat 4Site Engineers Ltd – Mat4Site
Kendall Flower Landscape Architecture - KFL
Environmental consultant - ECHO

SPECIFICATION SECTIONS

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Section	Title	Author	Pages
00 01 05	List of Specification Sections, Drawings and Schedules	SBA	9
00 01 07	Seals Sheet	SBA	1

DIVISION 1 – GENERAL REQUIREMENTS

00 01 08	Project and Consultant Identification	all	3
01 11 00	Summary of Work	All	2
01 14 00	Work Restrictions	SBA	2
01 21 00	Allowances	SBA	2
01 22 10	Contract Unit Prices	SBA	2
01 29 00	Payment Procedure	SBA	4
01 29 10	Sample Invoice Format	SBA	1
01 31 00	Project Managing and Coordination	SBA	4
01 32 00	Construction Progress Documentation	SBA	3
01 33 00	Submittal Procedures	SBA	5
01 35 23	Health and Safety	SBA	3
01 41 00	Regulatory Requirements	SBA	2
01 43 00	Quality Assurance	SBA	1
01 45 00	Quality Control	SBA	4
01 51 00	Temporary Utilities	SBA	3
01 52 00	Construction Facilities	SBA	4
01 53 00	Temporary Construction	SBA	3
01 54 23	Temporary Scaffolding and Platform	SBA	2
01 57 00	Temporary Control	SBA	5
01 61 00	Product Requirements	SBA	4
01 62 00	Product Exchange Procedure	SBA	2
01 70 00	Examination and Preparation	SBA	4
01 73 30	Cutting and Patching	SBA	3
01 74 00	Cleaning and Waste Processing	SBA	2
01 77 00	Closeout Procedures	SBA	2
01 78 10	Closeout Submittals	SBA	6
01 78 36	Warranties	SBA	1
01 79 00	Demonstration and Training	SBA	3

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Section	Title	Author	Pages
	DIVISION 2 – EXISTING CONDITIONS		
02 03 44	Shoring and Support of Period Structures	Tacoma	4
02 82 00	Abatement Scope and Details	City/ECOH	8
02 82 01	Type 1 Asbestos Abatement	City/ECOH	10
02 82 02	Type 2 Asbestos Abatement	City/ECOH	14
02 82 04	Type 3 Asbestos Abatement	City/ECOH	21
02 83 00	Lead Abatement	City/ECOH	23
02 83 10	Other Hazardous Materials	City/ECOH	18
02 84 00	PCB Capacitors and Ballasts	City/ECOH	10
	DIVISION 3 - CONCRETE		
03 11 00	Concrete Floor Finishing	SBA	4
03 20 00	Concrete Reinforcement	Tacoma	2
03 20 00	Concrete Reinforcing (Landscape)	KFL	6
03 30 00	Cast-In-Place Concrete (Landscape)	KFL	8
03 30 00	Cast-In-Place Concrete	Tacoma	5
03 33 00	Architectural Concrete	SBA	8
03 36 00	Sandblasted Concrete Finish	SBA	3
03 48 00	Precast Concrete Specialities	SBA	4
	DIVISION 4 – MASONRY		
04 03 41	Restoration Mortar	SBA	2
04 05 00	Common Work Results for Masonry	Tacoma	6
04 05 10	Masonry Mortar and Grout	Tacoma	3
04 05 19	Masonry Anchorage and Reinforcing	Tacoma	2
04 20 00	Unit Masonry	Tacoma	1
04 26 16	Reinforced Unit Masonry	Tacoma	6
	DIVISION 5 - METALS		
05 12 00	Structural Steel Framing	Tacoma	4
05 31 13	Steel Floor Decking	Tacoma	4
05 31 23	Steel Roof Decking	Tacoma	4
05 40 00	Cold Form Metal Framing	SBA	8
05 50 00	Metal Fabrications	Tacoma	4
05 52 00	Metal Handrails (Landscape)	KFL	6
	DIVISION 6 – WOOD, PLASTICS AND COMPOSITES		

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Section	Title	Author	Pages
06 03 10	Finish Carpentry Restoration & Replication	SBA	6
06 10 00	Rough Carpentry	Tacoma	4
06 10 53	Miscellaneous Rough Carpentry	Tacoma	3
06 20 00	Finish Carpentry and Cabinets	SBA	9

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07 13 00	Sheet Membrane Waterproofing	SBA	5
07 21 13	Board Insulation	SBA	5
07 21 29	Sprayed Insulation	SBA	5
07 26 00	Air Barrier, Air/Vapour Retarders	SBA	4
07 42 13	Standing Seam Zinc Wall Panels and Roofing	SBA	9
07 62 00	Sheet Metal Flashing and Trim	SBA	9
07 71 23	Gutters and Downspouts	SBA	3
07 84 00	Fire Stopping and Smoke Seals	SBA	6
07 92 00	Joint Sealants	SBA	7

DIVISION 8 – OPENINGS

08 12 13	Metal Doors and Frames	SBA	6
08 20 00	Wood Doors and Frames	SBA	4
08 44 13	Glazed Aluminum Curtain Walls and Skylight System	SBA	16
08 70 00	Door Hardware	SBA	6
08 80 50	Glazing	SBA	8

DIVISION 9 – FINISHES

09 03 98	Restoration Paint and Coating	SBA	7
09 21 16	Gypsum Board	SBA	9
09 22 16	Interior Non-load Bearing Metal Stud Framing	SBA	6
09 24 33	Cement Parging	SBA	4
09 30 20	Tiling	SBA	3
09 65 10	Resilient Flooring	SBA	4
09 68 13	Carpet Tiles	SBA	3

09 91 10	Paint and Coatings	SBA	8

DIVISION 10 – SPECIALITIES

10 28 14	Toilet and Bath Accessories	SBA	2

DIVISION 14 – CONVEYING EQUIPMENT

14 24 23	Hydraulic Elevators	SBA	14

DIVISION 21, 22, 23 and 25 – MECHANICAL

21 05 00	Common Work Results for Mechanical	Mat4Site	26
22 05 15	Plumbing Specialities and Accessories	Mat4Site	10
22 10 10	Plumbing Pumps	Mat4Site	3
22 11 17	Domestic Water Piping - Copper	Mat4Site	10
22 13 16	Drainage Waste and Vent Piping – Cast Iron and Copper	Mat4Site	4
22 13 17	Drainage Waste And Vent Piping - Plastic	Mat4Site	4
22 42 13	Plumbing Fixtures and Trim	Mat4Site	5
23 05 01	Operation and Maintenance HVAC Systems during Construction	Mat4Site	2
23 05 13	Common Motor Requirements for HVAC Equipment	Mat4Site	6
23 05 17	Pipe Welding	Mat4Site	5
23 05 19	Meters and Gauges for HVAC Piping	Mat4Site	4
23 05 29	Hangers and Supports for HVAC Piping and Equipment	Mat4Site	16
23 05 53	Mechanical Identification	Mat4Site	9
23 05 93	Testing, Adjusting and Balancing for HVAC	Mat4Site	12
23 07 13	Duct Insulation	Mat4Site	24
23 07 19	Piping Insulation	Mat4Site	12
23 08 13	Performance Verification of Mechanical Systems	Mat4Site	6
23 08 16	Cleaning and Start-up of HVAC Piping systems	Mat4Site	6
23 21 14	Hydronic Systems Piping and Valves	Mat4Site	12
23 21 16	Hydronic Specialities	Mat4Site	8
23 21 23	Hydronic Pumps	Mat4Site	9
23 22 13	Condensate Piping	Mat4Site	8
23 23 00	Refrigerant Piping	Mat4Site	6
23 25 00	HVAC Water Treatment	Mat4Site	8
23 31 13	Metal Ducts – Low Pressure to 1000 PA	Mat4Site	11
23 33 00	Air Duct Accessories	Mat4Site	5
23 33 14	Dampers - Balancing	Mat4Site	3

23 33 16	Damper – Fire and Smoke	Mat4Site	5
23 34 00	HVAC Fans	Mat4Site	11
23 37 13	Diffusers, Registers and Grilles	Mat4Site	5
23 52 00	Heating Boilers	Mat4Site	13
23 72 00	Air-to-Air Energy Recovery Equipment	Mat4Site	6
23 81 29	Variable Refrigerant Flow HVAC Systems	Mat4Site	10

DIVISION 26 – ELECTRICAL

26 05 00	Common Work Results for Electrical	Mat4Site	8
26 05 05	Mounting Heights	Mat4Site	2
26 05 10	Operation and Maintenance Manuals for Electrical	Mat4Site	5
26 05 20	Wire and Box Connectors (0-1000V)	Mat4Site	2
26 05 21	Wire and Cables	Mat4Site	8
26 05 22	Connectors and Terminations	Mat4Site	1
26 05 28	Grounding - Secondary	Mat4Site	5
26 05 29	Hangers and Supports for Electrical Systems	Mat4Site	2
26 05 31	Splitters, Junction, Pull Boxes and Fittings	Mat4Site	2
26 05 32	Outlet Boxes, Conduit Boxes and Fittings	Mat4Site	3
26 05 34	Conduits, Conduit Fasteners and Conduit Fittings	Mat4Site	5
26 05 43	Concrete Encased Duct Banks	Mat4Site	5
26 05 73	Power System Study	Mat4Site	8
26 05 88	Cutting and Patching	Mat4Site	2
26 08 00	Commissioning of Electrical	Mat4Site	10
26 09 24	Lighting Control Devices – Low Voltage	Mat4Site	4
26 24 01	Service Equipment	Mat4Site	2
26 24 02	Service Entrance Board	Mat4Site	4
26 24 17	Panelboards Breaker Type	Mat4Site	3
26 27 26	Wiring Devices	Mat4Site	3
26 28 14	Fuses Low Voltage	Mat4Site	3
26 28 17	Molded Case Circuit Breakers	Mat4Site	3
26 28 20	Ground Fault Circuit Interrupters – Class A	Mat4Site	3
26 28 23	Disconnect Switches – Fused and Non-Fused	Mat4Site	1
26 50 00	Lighting	Mat4Site	7
27 00 00	Communications Specifications	Mat4Site	9
28 00 00	Security Specifications	Mat4Site	7
28 31 02	Fire Alarm System - Modification	Mat4Site	3

DIVISION 31 – EARTHWORK

31 00 00	Earthwork	SBA	9

31 05 16	Aggregate Materials (Landscape)	KFL	5
31 22 13	Rough Grading (Landscape)	KFL	3
31 23 33	Excavating, Trenching, Backfill (Landscape)	KFL	7

DIVISION 32– EXTERIOR IMPROVEMENTS

32 11 23	Aggregate Base Courses (Landscape)	KFL	3
32 16 00	Concrete Paving (Landscape)	KFL	5
32 33 00	Site Furnishings (Landscape)	KFL	4
32 91 19.13	Topsoil and Fine Grading (Landscape)	KFL	4
32 92 23	Sodding (Landscape)	KFL	4
32 93 10	Plantings (Landscape)	KFL	7

DIVISION 33– UTILITIES

33 46 13	Foundation Drainage	SBA	3

LIST OF DRAWINGS

DRAWING NO	TITLE	AUTHOR	DATE
ARCHITECTURAL			
A01	Cover Page, drawing list & context	SBA	Oct. 20, 2023
Survey		Speight, Van Nostrand & Gibson Limited	
A02a	Proposed Site Plan – Overall Site	SBA	Oct. 20, 2023
A02b	Proposed Site Plan at Addition		Oct. 20, 2023
A03	OBC Matrix & Fire Separation	SBA	Oct. 20, 2023
A04	Construction Assemblies	SBA	Oct. 20, 2023
A100	Ex. Basement Plan – Demolition	SBA	Oct. 20, 2023
A101	Ex. Ground FL. Plan – Demolition	SBA	Oct. 20, 2023
A102	Ex. 2nd FL. Plan – Demolition	SBA	Oct. 20, 2023
A103	Ex. Basement Floor Plan – Proposed	SBA	Oct. 20, 2023
A104	Ex. Ground Floor Plan – Proposed	SBA	Oct. 20, 2023
A105	Ex. 2nd Floor Plan – Proposed	SBA	Oct. 20, 2023
A106	Ex. Roof Plan – Proposed	SBA	Oct. 20, 2023
A200	Basement RCP – Demolition & Proposed	SBA	Oct. 20, 2023
A201	Ground Floor RCP – Demolition & Proposed	SBA	Oct. 20, 2023
A202	2nd Floor RCP – Demolition & Proposed	SBA	Oct. 20, 2023

A300	West and North Elevations - Restorations	SBA	Oct. 20, 2023
A301	East and South Elevations - Restorations	SBA	Oct. 20, 2023
A302	Photos	SBA	Oct. 20, 2023
A500	Building Section	SBA	Oct. 20, 2023
A501	Building Section	SBA	Oct. 20, 2023
A502	Building Sections	SBA	Oct. 20, 2023
A510	Section Details	SBA	Oct. 20, 2023
A511	Section Details	SBA	Oct. 20, 2023
A512	Section Details	SBA	Oct. 20, 2023
A513	Section Details	SBA	Oct. 20, 2023
A514	Section Details	SBA	Oct. 20, 2023
A515	Section Details	SBA	Oct. 20, 2023
A516	Section Details	SBA	Oct. 20, 2023
A517	Section Details	SBA	Oct. 20, 2023
A518	Section Details	SBA	Oct. 20, 2023
A600	Stairs Detail – Plan and Elevation	SBA	Oct. 20, 2023
A601	Stairs Detail – Section	SBA	Oct. 20, 2023
A602	Stairs Detail - Section	SBA	Oct. 20, 2023
A700	Ramp Details	SBA	Oct. 20, 2023
A701	Ramp Details	SBA	Oct. 20, 2023
A702	Kitchen Details	SBA	Oct. 20, 2023
A703	Washrooms Details	SBA	Oct. 20, 2023
A704	Interior Base and Trim Details	SBA	Oct. 20, 2023
A800	Finishes Plan	SBA	Oct. 20, 2023
A801	Finishes Plan and Schedule	SBA	Oct. 20, 2023
A900	Door and Hardware Schedule	SBA	Oct. 20, 2023
A901	Door Details	SBA	Oct. 20, 2023
A902	Window Details	SBA	Oct. 20, 2023
A903	Glazing Schedule	SBA	Oct. 20, 2023

STRUCTURAL

S1.1	Foundation Plan	Tacoma	Oct. 23, 2023
S2.1	Main Floor Framing Plan	Tacoma	Oct. 23, 2023
S2.2	Second Floor Framing Plan	Tacoma	Oct. 23, 2023
S2.3	Roof Framing Plan	Tacoma	Oct. 23, 2023
S3.1	Section	Tacoma	Oct. 23, 2023

MECHANICAL

M-100	General Notes, Legends and Schedules	Mat4Site	Oct. 20, 2023
M-101	Schedule	Mat4Site	Oct. 20, 2023
M-200	Basement – Plumbing - Demolition	Mat4Site	Oct. 20, 2023
M-201	Basement – Plumbing below grade – Modification	Mat4Site	Oct. 20, 2023
M-202	Ground Floor – Plumbing – Demolition and Modification	Mat4Site	Oct. 20, 2023

M-203	2nd Floor – Plumbing – Demolition and Modification	Mat4Site	Oct. 20, 2023
M-300	Basement – HVAC – Demolition and Modification	Mat4Site	Oct. 20, 2023
M-301	Ground Floor – HVAC – Demolition and Modification	Mat4Site	Oct. 20, 2023
M-302	2nd Floor – HVAC – Demolition and Modification	Mat4Site	Oct. 20, 2023
M-303	Attic – HVAC – Modification & Basement Mechanical Room.	Mat4Site	Oct. 20, 2023
M-500	Basement – Hydronics – Modification	Mat4Site	Oct. 20, 2023
M-501	Ground Floor – Hydronics – Modification	Mat4Site	Oct. 20, 2023
M-502	2nd Floor – Hydronics – Modification	Mat4Site	Oct. 20, 2023
M-800	Schematics	Mat4Site	Oct. 20, 2023
M-1000	Details	Mat4Site	Oct. 20, 2023

ELECTRICAL

E-100	General Notes, Legends and Schedules	Mat4Site	Oct. 20, 2023
E-101	Site Plan – Electrical	Mat4Site	Oct. 20, 2023
E-200	Basement – Lighting – Demolition and Modification	Mat4Site	Oct. 20, 2023
E-201	Ground Floor - Lighting – Demolition and Modification	Mat4Site	Oct. 20, 2023
E-203	2nd Floor - Lighting – Demolition and Modification	Mat4Site	Oct. 20, 2023
E-300	Basement – Power & Systems – Demolition and Modification	Mat4Site	Oct. 20, 2023
E-301	Ground Floor – Power & System – Demolition and Modification	Mat4Site	Oct. 20, 2023
E-302	2nd Floor – Power & System – Demolition and Modification	Mat4Site	Oct. 20, 2023
E-306	Attic – Power and System - Modification	Mat4Site	Oct. 20, 2023
E-800	Luminaire Schedule	Mat4Site	Oct. 20, 2023
E-801	Panel Schedules	Mat4Site	Oct. 20, 2023
E-900	Single Line Diagram	Mat4Site	Oct. 20, 2023
E-1000	Details	Mat4Site	Oct. 20, 2023
E-1001	Details	Mat4Site	Oct. 20, 2023

LANDSCAPE

L0	Landscape Removals Plan	KFL	Oct. 20, 2023
L1	Landscape Plan	KFL	Oct. 20, 2023
L2	Landscape Details	KFL	Oct. 20, 2023
L3	Landscape Details	KFL	Oct. 20, 2023
L4	Landscape Details	KFL	Oct. 20, 2023

Appendix A:

- Designation ByLaw (124-76) for 285 Spadina Road
- Spadina National Historic Site designation, July 2019.

Appendix B:

- Analysis of Finishes on an Exterior Door at Spadina House Museum, dated October 31, 2016.
- Examination and Test Report for Spadina House Museum Exterior Garage Doors, dated December 7, 2016.

Appendix C:

- Arborist Report, dated Aug. 1, 2023. Prepared by Amy Choi Consulting.
- Tree Protection Plan, dated Aug. 1, 2023. Prepared by Amy Choi Consulting.

Part 1 General

1.1 PROJECT TITLE

Spadina Museum – Garage Rehabilitation and Site Accessibility
285 Spadina Road
Toronto, ON.
SBA Project No. A22048

1.2 OWNER

City of Toronto
Metro Hall, 8th Floor, 55 John Street.
Toronto, ON.

Project Manager: Sandra Lougheed

1.3 CONSULTANTS

.1 Architectural

Stevens Burgess Architects Ltd.
120 Carlton Street, Suite 204
Toronto, Ontario M5A 4K2

Attention: Sheldon Kennedy and Ivy Lai
Telephone: (416) 961-5690
Facsimile: (416) 972-6417
Email: sheldonk@sba.on.ca
ivyl@sba.on.ca

.2 Structural

Tacoma Engineers Inc.
176 Speedvale Ave. West
Guelph, Ontario N1H 1C3

Attention: Arlin Otto
Telephone: (519) 763-2000 x 268
Email: a.otto@tacomaengineers.com

.3 Mechanical

Mat 4Site Engineers Ltd.
620 Wilson Ave., Suite 320
North York, Ontario M3K 1Z3

Attention: Rinkesh Shah

Telephone: (416) 229-6574
Email: rinkesh@mat4site.com

.4 Electrical

Mat 4Site Engineers Ltd.
620 Wilson Ave., Suite 320
North York, Ontario M3K 1Z3

Attention: Alan Lam
Telephone: (416) 229 -6574
Email: alan@mat4site.com

.5 Landscape

Kendall Flower Landscape Architecture

Attention: Kendall Flower
Telephone: (226) 971-1009
Email: kendall@kendallflower.com

.6 Arborist

Amy Choi Consulting

Attention: Amy Choi
Telephone: (647) 983-8817
Email: info@achoiconsulting.ca

.7 Archeology

Archaeological Research Associates Ltd. (ARA)

Attention: Sarah Bolstridge
Telephone: (519) 804 -2291 x 112
Email: sarah.bolstridge@araheritage.ca

.8 Environmental

ECOH Management Inc.
75 Courtneypark Dr. West, Unit#1
Mississauga, Ontario L5W 0E3

1.4 BASE BUILDING CONTRACTORS

.1 Security

Graham Alarm Monitoring Ltd.
Telephone: 905-897-8822

.2 Fire and Life Safety

Eurotech Safety Inc.
1895 Clements Rd, Unit 126
Pickering, ON.
Telephone: 905-239-1005

1.5 PRE-QUALIFIED SUB CONTRACTORS

.1 Abatement

Bear Star Group. Attention: Jayson Deslauiers.
Email: jason@bearstargroup.com

JMX Environmental. Attention: Matt Richard.
Email: matt.richard@jmxenv.com.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 HERITAGE SIGNIFICANCE AND HISTORY

1.2.1 In 1976 the City of Toronto designated the property under Section 24 of the Ontario Heritage Act for architectural value. . Refer to Appendix A.

1.2.2 In 2019, the property was designated as a National Historic Site under the Historic Sites and Monument Act (R.S.C., 1985, c.H-4). Refer to Appendix B.

1.2.3 Both the above municipal designation by-law and the national historic site designation do not capture details particular to the Chauffeur's Residence and Garage. As noted in **Section VI,** SBA conducted independent research and an evaluation as per O. Reg. 9/06[1] to understand better the history and design of the built form and context of the chauffeur's residence and garage in relation to the rest of the museum property.

The following is SBA's DRAFT Statement of Cultural Heritage Value:

Statement of Cultural Heritage

The Garage & Chauffeur's Residence at 285 Spadina Road is part of the Spadina National Historic Site in Toronto. Constructed in 1909 in the Arts & Crafts style, the garage/chauffeur's residence was part of a series of changes that Albert Austin made to the Spadina estate in the early 20th century. While included in the designation of the property, the garage/chauffeur's residence has heritage value in its own right and reflects a different dimension of the history of the Austin House and its denizens.

Design
It is representative of the Arts & Crafts design style with the functionality of the space integrated into the design. The use of stone, wood, and brick materials on the exterior is a hallmark of this design style. The garage and residence were designed such that the west and south elevations were the most visually prominent with the highest concentration of architectural and design elements located on them so as to connote the front of the house.

Historical
The garage/chauffeur's residence is associated with the early 20th century theme of the era of the automobile. It is also associated with the lifestyle of the social elite of Toronto.

The building has direct associations with Austin Family who owned the estate that is now the national historic site and particularly Albert Austin who had initiated an extensive programme of renovations for the property.

The Garage / Chauffer's residence has the potential to yield information that contributes to a more fulsome picture of the life of the Austin family and their servants/employees, as well as the nature of domestic service in Toronto throughout the 20th century.

From a curatorial perspective, the building contributes to an understanding of the evolution of the site from a residence to a museum and how architectural artifacts have been programmed to help with the museum's mandate.

Contextual
The building is physically, functionally, visually, and historically linked to this well preserved national historic site, and former Austin Family estate. The pedestrian paths and internal circulation help to provide legibility of the historic configuration of the property as well as the relationships between the family and their servants.

Heritage Attributes:

.1 Massing of the 1 ½ storey residence

- .1 Returns on both the north and south sides

.2 Integration of the carport / garage into the residence

- .1 Supporting column groupings and arched connections with decorative trims, fascia, and cornices
- .2 Vehicle inspection pit, curb, access stair, and associated window and window well at the east of the garage
- .3 Large garage windows including the window on the east elevation that extends below grade for light to enter the inspection pit.
- .4 Hinged, wooden garage doors with divided lights

.3 Cedar-shingled roof

.4 East dormer with cedar shingle cladding

.5 Wood entry doors from the carport and garage, and at the east

.6 Exterior materiality including

- .1 Stone
- .2 Stucco
- .3 Cedar shingles (roof and dormer walls)
- .4 Wood brackets, bargeboards, trim, and wood detailing

.7 Stone chimney

.8 Window and window openings

- .1 Divided light and storm windows
- .2 Inclusive of sills, trim, and hardware both on the exterior and interior

1.3 SCOPE OF WORK

1.3.1 The purpose of this project is to complete accessibility upgrades for the overall ground and the Garage. All work is to be completed with minimal impact on the existing heritage attributes.

1.3.2 The work shall include but is not limited to the following:

.1 Renovation of existing Garage and new addition:

.1 Remove existing structure, wall, floor, finishes, equipment and etc.as shown on drawings. Refer to abatement for required removal procedure.

.2 Construct new addition for LULA elevator, elevator machine room and stairs as shown on drawings.

.3 Renovate existing Garage as shown on drawings. Work includes framing reinforcement, finishes, millwork, plumbings and etc.

.4 Provide structural, mechanical and electrical as shown on drawings to suit renovation and addition.

.2 Site Improvement:

.1 Remove existing landscaping elements as shown on drawings.

.2 New concrete walkway, pavers and stairs as shown on drawings.

.3 New site furniture, signage and planting as shown on drawings.

.4 New electrical to support digital signage.

1.4 SPECIAL REQUIREMENTS

1.4.1 Work to start as soon as PO is issued. Site mobilization may commence December, 2023 and construction is to be completed by November 31, 2024, in order to qualify for full grant funding.

1.4.2 Work is to be coordinated with Owner's representatives to minimize disruption to Museum programs. There will be no public access to the Spadina Museum Garage during the construction period.

1.4.3 Cultural Heritage Resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.

1.4.4 Power, water and gas to Stable and Greenhouse are fed from Garage. Ensure all utilities servicing to adjacent buildings are maintained during construction.

1.4.5 Existing hose bib on Garage east elevation is to be maintained during construction except for winter month.

1.4.6 Protection (temporary fence or barrier) around Stable is required to ensure existing building is not damaged by vehicle and construction activities.

1.4.7 Spadina Musuem, Stable, Greenhouse and the ground are to remain available for public and Museum's use during the construction period.

1.4.8 When egress routes are compromised by construction activities, signage is to be posted and Museum are to be notified.

1.4.9 On site storage, staging, and garbage areas are limited. Garbage is to be removed from the site at the end of each work day.

1.4.10 All work is to be done in accordance with best conservation practices and performed by trades skilled in heritage work.

1.5 STAFFING REQUIREMENTS

1.5.1 A dedicated full-time project manager is required. The project manager must be as named in the bid documents, unless alternate approved by the Consultant.

1.5.2 Key Site Personnel named in the bid documents must be used, unless alternate approved by the Consultant.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Connecting to existing services.

.2 Special scheduling requirements.

1.2 RELATED SECTIONS

.1 Section 01 53 00 - Temporary Construction.

.2 Section 01 33 00 - Submittal Procedures.

.3 All other Division 01 specification sections.

.4 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 RESTRICTIONS ON USE OF PREMISES

.1 Limit use of premises (the buildings and the ground) to allow;

.1 Owner occupancy.

.2 Public usage.

.2 Coordinate use of premises under direction of Owner.

1.4 WORK SEQUENCE

.1 Schedule and construct Work in stages to accommodate Owner's continued use of premises during construction.

.2 Schedule and construct Work in stages to provide for continuous public usage. Do not close off public usage until use of one stage of Work will provide alternate usage.

1.5 OWNER USE AND OCCUPANCY OF PREMISES

.1 Owner will occupy premises during entire construction period.

.2 Cooperate with Owner in scheduling operations to minimize disruptions and to facilitate Owner usage.

.3 The Garage will not be occupied and will remain so for the duration of the Work.

.4 The Spadina Musuem, Stable, Greenhouse and the grounds will continued to be used and occupied during construction for Owner and Museum programs

.5 All Work shall be scheduled and co-ordinated to accommodate the building occupants and all necessary precautions shall be taken to ensure safe occupancy. Coordinate use of premises under direction of the Owner.

.6 The Owner will vacate the Garage during the construction period. However, there may be specific identified time when the need may arise for the Owner to visit or use the site. Such times will be scheduled beforehand and co-ordinated with the Contractor. Contractor to accommodate these requests and make all necessary precautions to ensure the safety of the Owner.

.7 The Owner will remove personal furniture, and office equipment prior to construction. Relocate furniture as shown on drawing. Make good all damage to the satisfaction to the Owner. Relocate all furnishings and equipment remaining in rooms, as needed to execute the Work, and return same to original location before Owner reoccupies rooms or spaces.

.8 Take all necessary measures and as directed by the Owner to minimize disruption of the site and its use by the occupants and public.

.9 Coordinate access to the building with the Owner and security.

.10 Exits and paths of egress are to remain clear and accessible at all times. Division of the Work among suppliers or vendors, and sub-contracts is solely the Contractor's responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of Work.

1.6 RESTRICTIONS ON CONTACTOR MOVEMENT

.1 Contractor personnel are restricted to the job site and necessary access routes. No personnel shall visit other buildings without prior authorization. The extent of the Work site shall be confined to the areas in which Work is occurring and access routes to those areas.

1.7 HOURS OF WORK

.1 Typical Days and Hours of work : Monday to Friday. 8am to 5pm.

.2 Accommodate Museum as required for any summer camp program or events that may restrict hours of work.

.3 Allow for hours of work restrictions in construction progress schedule.

1.8 NOISY WORK RESTRICTIONS

.1 Any noise generating work to be completed in compliance with City of Toronto's Noise By-Laws.

.2 Schedule excessively noisy work to avoid disturbance to building occupants. Perform excessive noise generating work outside of Owner's business hours.

.3 Use powder actuated devices only with Consultant's written permission.

1.9 SPECIAL REQUIREMENTS

.1 Perform work at Owner occupied Spadina Museum:

.1 From Monday to Friday from 8am to 5pm only.

.2 On Saturdays, Sundays, and statutory holidays to Owner approval.

.2 All deliveries are to be made during working hours. Schedule for deliveries to be coordinated through Owner.

.3 Submit schedule of special requirements or disruptions in accordance with Section 01 33 00 – Submittal Procedures.

1.10 EXISTING SERVICES

.1 Notify Owner, Consultant and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give Owner, forty-eight (48) hours of notice for necessary interruption of mechanical or electrical service throughout course of Work.

.1 Keep duration of interruptions minimum.

.2 Perform interruptions after normal working hours of occupants, preferably on weekends.

.3 Construct barriers in accordance with Section 01 53 00 – Temporary Construction.

1.11 MAINTAINING LIFE SAFETY SYSTEMS IN OCCUPIED FACILITIES

.1 Maintain operational life safety systems and public access to exits in occupied areas during all stages of the Work.

.2 Determine nature and exact locations of existing fire and smoke sensors prior to the commencement of the Work. Avoid direct or indirect jarring while working in adjacent areas and exercise caution to avoid triggering these devices.

.3 Be responsible for costs incurred by Owner on account of false fire alarms activated as a result of the execution of the Work without adequate precautions.

1.12 MAINTAINING EXISTING UTILITIES SYSTEMS IN OCCUPIED FACILITIES

.1 Maintain operational power, water and gas in occupied areas during all stages of the Work.

.2 Existing power, water and gas to Stables and Greenhouse are fed from Garage. Contractor to ensure continuing operation of Stables and Greenhouse during construction.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Cash allowances.

.2 Inspection and testing allowances.

.3 Contingency allowance.

1.2 RELATED SECTIONS

.1 Section 01 29 00 - Payment Procedures.

.2 Section 01 62 00 - Product Exchange Procedures.

.3 This section describes requirements applicable to all Sections.

1.3 CASH ALLOWANCES

.1 Costs Included in Cash Allowances: Cost of Product to Contractor less applicable trade discounts; delivery to site, and applicable taxes.

.2 If a Cash Allowance item described in the Allowances Schedule below indicates the inclusion of installation, include in the Cash Allowance amount, provision for Product handling at the site, including unloading, uncrating, storage, protection of Products from elements and from damage, labour for installation and finishing, insurance, labour costs, taxes, bonding if applicable, equipment rental, overhead and profit.

.3 If a Cash Allowance item described in the Allowances Schedule below indicates supply only, include in the Contract Price costs not included in Cash Allowances but included in the Contract Price: Product handling at the site including unloading, uncrating, storage, protection of Products from elements and from damage, labour for installation and finishing, insurance, labour costs, taxes, bonding if applicable, equipment rental, overhead and profit.

.4 Contract Sum, and not Cash Allowance(s) includes Contractor's overhead, profit and other associated costs not specifically stated to be covered in Cash Allowance(s), in connection with such Cash Allowances(s).

.5 Consultant Responsibilities:

.1 Consult with Contractor for consideration and selection of Products, suppliers, and installers.

.2 Owner and Consultant to select Products.

.3 Prepare Approval for Allocation of Cash Allowance (AACA), and Change Orders (CO).

.6 Contractor Responsibilities:

.1 Assist Consultant in selection of Products, suppliers and installers.

.2 Obtain proposals from suppliers and installers and offer recommendations.

.3 On notification of selection by Consultant or Owner, execute purchase agreement with designated supplier and installer.

.4 Arrange for and process shop drawings, product data, and samples. Arrange for delivery.

.5 Promptly inspect Products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

.7 Differences in costs will be adjusted by Change Order.

.8 Individual cash allowances are for budget purposes only and may be transferred from one allowance to another or used for other Work at the discretion of the Owner. At the completion of the Work, any remaining or unspent portions of individual cash allowances will be credited to Owner through written Notice of Change.

.9 Allowances:

.1 Conservation and restoration of garage door 101E1, 101E2 and 101E3.

.1 Contractor to obtain 3 quotations from painting conservators for Owner's review and approval. Painting conservator shall be a member of Canadian Association of Professional Conservators. https://capc-acrp.ca

.2 Refer to drawing A302 for scope of work.

.3 Cash Allowance for the amount of **$15,000.00**

1.4 CASH ALLOWANCES FOR SUPPLY ONLY PRODUCTS

.1 Amount of each cash allowance includes:

.1 Cost of Products as invoiced by the Supplier, including delivery and applicable taxes but excluding Value Added Taxes.

.2 Amount of each cash allowance does not include costs of the following items, which costs shall be included in the Contract Price and not in the cash allowance:

.1 Unloading, handling and storage on site.

.2 Installation and all other related costs.

.3 Overheads and profits related to the cash allowance.

.3 Allow the stipulated sum of **$ 75,000.00** for the supply of:

.1 Architectural Door Hardware. Refer to Section 08 71 00 for the amount of $30,000.00.

.2 Furniture $ 5,000.00.

.3 Wall and floor porcelain tiles. $5,000.00

.4 One (1) Main site entrance sign (including digital program): $35,000.00

1.5 INSPECTING AND TESTING ALLOWANCES

.1 Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.

.2 Costs Not Included in the Inspecting and Testing Allowance But Included in the Contract Price:

.1 Costs of incidental labour and facilities required to assist inspecting or testing agency.

.2 Costs of testing services used by Contractor separate from Contract Document requirements.

.3 Costs of retesting upon failure of previous tests as determined by Consultant.

.3 Payment Procedures:

.1 Submit [one (1) copy of the inspecting or testing firm's invoice with next application for payment.

.2 Pay invoice on approval by Consultant.

.4 Allow the stipulated sum of **$ 15,000.00** for Inspecting and Testing Allowances for:

.1 testing compacted soils specified in Division 31 and 32.

.2 testing concrete, re-bar review, structural welds, etc. specified in Division 3, 4 and 5

.3 Any other testing requested by Consultants.

.4 Retain Geotechnical engineer for investigation and soil report.

.5 Differences in cost will be adjusted by Change Order.

1.6 CONTINGENCY ALLOWANCE

.1 Include in the Contract, for use upon Owner's written instruction via Change Order.

.2 Contractor's costs for Products, delivery, installation, labour, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

.3 Funds will be drawn from the Contingency Allowance only by Change Order.

.4 At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Quantity measurement with unit value of Products determined by and expanded in the Bid Documents.

.2 Schedule of Products and their quantities.

.3 Schedule of applicable values.

1.2 RELATED SECTIONS

.1 Refer to CCDC 2-2020 for specific contractual requirements.

.2 Section 01 29 00 – Payment Procedures: Application for Payment.

.3 Section 01 62 00 - Product Exchange Procedures: Substitutions and Modification Requirements.

.4 All Division 01 specification sections.

1.3 SCHEDULE OF VALUES

.1 Submit a printed schedule of values.

.2 Submit Schedule of Values within ten (10) days after date Owner-Contractor Agreement].

.3 Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the primary associated specification section. Also identify site mobilization, bonds and insurance, close out document and allowances.

.4 Each primary line item described above maybe further broken down as per Consultant's review.

.5 Include within each line item, a direct proportional amount of Contractor's overhead and profit.

.6 Revise schedule to list approved Change Orders, with each Application for Payment.

1.4 SCHEDULE OF UNIT PRICE ITEMS

.1 Specify the following paragraphs if unit costs form the basis of contract price (CCDC 3, 4, or 18). CCDC 2 can also be used for identifying special or specific unit price items - edit the following as required .

.2 Submit a separate price table of unit price items of Work.

.3 Make form of submittal parallel to Schedule of Values, with each line item identified same as line item in Schedule of Values. Include in unit prices only:

.1 Cost of material.

.2 Delivery and unloading at site.

.3 Sales taxes.

.4 Installation, overhead and profit.

.4 Ensure unit prices multiplied by quantities given equal material cost of that item in Schedule of Values.

.5 Make form of submittal parallel with each line item as per Unit Price Bid Form:

.1 Additional columns are to be added for Inventoried Quantity and work completed.

.2 Once contractors repair inventory has been signed off, an inventory column will be populated.

.3 As work is completed, the work completed columns will be updated.

.6 Ensure unit prices multiplied by quantities given equal material cost of that item in Schedule of Values.

1.5 MEASUREMENT OF QUANTITIES

.1 Measurement Devices:

.1 Weigh Scales: Inspected, tested and certified by the applicable authority for weights and measures, within the past [year].

.2 Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.

.3 Metering Devices: Inspected, tested and certified by the applicable authority within the past year.

.2 Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes - measured by handbook weights. Welded assemblies measured by handbook or scale weight.

.3 Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

.4 Measurement by Area: Measured by square dimension using mean length and width or radius.

.5 Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

.6 Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination as appropriate, as a completed item or unit of Work.

1.6 MEASUREMENT AND PAYMENT - UNIT PRICES

.1 Authority for Specified Conditions: Measurement methods are delineated in the individual specification sections.

.2 Authority for Changed Conditions: Measurement methods and unit prices are determined by the Consultant.

.3 Select one or the other of the following two paragraphs.

.4 Take measurements and compute quantities. The Consultant will verify measurements and quantities.

.5 Unit Quantities: Quantities and measurements indicated in the Bid Form are for bid and contract purposes only. Quantities and measurements actually supplied or placed in the Work shall determine payment.

.6 Payment Includes: Full compensation for required labour, Products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.7 DEFECT ASSESSMENT

.1 Replace the Work, or portions of the Work, not conforming to specified requirements.

.2 If, in the opinion of the Consultant, it is not practical to remove and replace the Work, the Consultant will direct one of the following two (2) remedies:

.1 The defective Work may remain, but the unit sum/price will be adjusted to a new sum/price at the discretion of the Consultant.

.2 The defective Work will be partially repaired to the instructions of the Consultant, the unit sum/price will be adjusted to a new sum/price at the discretion of the Consultant.

.3 The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.

.4 The authority of the Consultant to assess the defect and identify payment adjustment, is final.

1.8 NON-PAYMENT FOR REJECTED PRODUCTS

Payment will not be made for any of the following:

.1 Products wasted or disposed of in a manner that is not acceptable.

.2 Products determined as unacceptable before or after placement.

.3 Products not completely unloaded from the transporting vehicle.

.4 Products placed beyond the lines and levels of the required Work.

.5 Products remaining on hand after completion of the Work.

.6 Loading, hauling, and disposing of rejected Products.

1.9 UNIT PRICE SCHEDULE

.1 Refer to the Unit Price Bid Form.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Applications for progress payments.

.2 Substantial performance procedures.

.3 Release of hold-back procedures.

.4 Price adjustments.

1.2 RELATED DOCUMENTS

.1 Section 01 62 00 - Product Exchange Procedures.

1.3 RELATED SECTIONS

.1 Section 01 62 00 - Product Exchange Procedures.

1.4 APPLICATIONS FOR PROGRESS PAYMENT

.1 In addition to other requirements of the Contract, the following information applies to applications for payments, and applications under the Construction Lien Act.

.2 Progress applications:

.1 Progress applications for payment shall indicate the value complete of each item in the Schedule of Values, percentage complete to date of application, value previously certified for payment by the Consultant, and value of work remaining. Refer to 01 29 10 – Sample Invoice Format for ample progress invoice format. All values shall be exclusive of HST, except that HST shall be applied to the total amount claimed, and the value of HST indicated on the application.

.2 Include a summary of changes with application for payment, showing values complete.

.3 No payment will be made for Products ordered or manufactured, but not yet delivered to the Place of the Work.

.4 Include evidence to support claims for Products delivered to the Place of the Work, but not yet incorporated into the Work, as the Consultant may require to establish the value and delivery of the products

.5 Products delivered to the Place of the Work are the property of the Owner and shall not be removed without the Owner's consent, except where rejected as defective products or removed as legitimate debris.

.6 In addition to other requirements, progress applications shall indicate the cost of the following items as separate items:

.1 Bonds

.2 Insurances

.3 Temporary facilities and controls

.4 Contract closeout, record and as-built drawings, maintenance and operating manuals.

.3 Make applications for payment on account monthly as Work progresses.

.4 Accompany applications with a CCDC 9A-2001 Statutory Declaration form.

.5 Date applications for payment last day of agreed payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work as of that date.

.6 Submit to Consultant for review, minimum fourteen (14) days before first application for payment, schedule of values for parts of Work, aggregating total amount of Contract Price, so as to facilitate evaluation of applications for payment.

.7 Submit required support documentation with applications for payment, including workers' compensation clearance certificates and statutory declarations.

.8 Consultant will issue to Owner, no later than ten (10) days after receipt of an application for payment, certificate for payment in amount applied for or in such other amount as Consultant determines to be properly due.

.9 If Consultant amends application, Consultant will give notification in writing giving reasons for amendment.

1.5 SUBSTANTIAL PERFORMANCE OF THE WORK

.1 Applications for a Certificate of Substantial Performance, release of holdback, and Statement of Completion shall be completed in accordance with OAA/OGCA Document 100 Takeover Procedures (latest edition). In document 100, substitute “Consultant” for “Architect”, and “review” for inspection where it appears in relation to the Consultant’s assessment of the work.

.2 Accompany applications with a CCDC 9A-2001 Statutory Declaration form.

.3 Accompany application with current Workers’ compensation Clearance Certificate.

.4 Prepare and submit to Consultant a comprehensive list of items to be completed or corrected. Failure to include an item on the list does not alter responsibility to complete the Contract.

.5 Request Consultant review to establish Substantial Performance of the Work.

.6 Where permitted by local lien legislation, Contractor may apply for substantial performance of a designated portion of the Work, subject to Owner acceptance of that portion of the Work being substantially performed.

.7 No later than ten (10) days after receipt of list and application, Consultant will review Work to verify validity of application, and no later than seven (7) days after completing review, will notify Contractor if the Work, or the designated portion of the Work, is substantially performed.

.8 Consultant will state in their certificate the date of Substantial Performance of the Work, or the date of the designated portion of the Work, as applicable.

.9 Immediately following issuance of certificate of Substantial Performance of the Work, in consultation with Consultant, establish reasonable date for finishing Work.

1.6 PAYMENT OF HOLD-BACK ON SUBSTANTIAL PERFORMANCE OF THE WORK

.1 After issuance of Certificate of Substantial Performance of the Work:

.1 Submit an application for payment of hold-back amount.

.2 Submit sworn statement that all accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of the Work and for which Owner might in any way be held responsible have been paid in full, except for amounts properly retained as hold-back or as identified amount in dispute.

.3 Submit proof of Publication of the Certificate of Substantial Performance from the publishing newspaper (Daily Commercial News).

.2 After receipt of application for payment, sworn statement and proof of publication, Consultant will issue certificate for payment of hold-back amount.

.3 Where the Contractor does not publish the Certificate of Substantial Performance within 10 calendar days of the Consultant's issuance of the Certificate, the Owner may, at the Owner's sole discretion, publish the Certificate of Substantial Performance, deducting the cost of the publication from the Contract Price. Cost of publication will include the advertising fees, plus Owner's and Consultant's labour costs charged at regular hourly rates for time involved in arranging publication. Where there are no regular hourly rates, costs shall be charged at hourly salary or wages multiplied by 3.

.4 Amount authorized by certificate for payment of hold-back amount is due and payable on day following expiration of hold-back period stipulated in lien legislation applicable to Place of the Work.

.1 Where lien legislation does not exist or apply, hold-back amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties.

.2 Owner may retain out of hold-back amount any sums required by law to satisfy any liens against Work or, if permitted by lien legislation applicable to Place of the Work, other third party monetary claims against Contractor which are enforceable against Owner.

1.7 FINAL PAYMENT

.1 Submit an application for final payment. Application to confirm to standards identified in paragraph 1.4.

.2 Consultant will, no later than ten (10) days after receipt of an application for final payment, review Work to verify validity of application. Consultant will give notification that application is valid or give reasons why it is not valid, no later than seven (7) days after reviewing Work.

.3 Consultant will issue final certificate for payment when application for final payment is determined valid.

1.8 PAYMENT OF FINISHING HOLDBACK

.1 Finishing holdback monies will be released in accordance with applicable legislation once the Consultant deems the project work complete.

.1 Contractor to submit an application for payment for finishing holdback amount.

.2 Submit sworn statement that all accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of the Work and for which Owner might in any way be held responsible have been paid in full, except for amounts properly retained as hold-back or as identified amount in dispute.

.2 After receipt of applicable payment and sworn statement, Consultant will issue Certificate for Payment of finishing holdback amount.

.3 Consultant will issue final certificate for payment when application for final payment is determined valid.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

1.0 Sample Invoice Format

.1 Refer to Section 01 29 00 for Payment Procedures

.2 The following illustrates a sample format to follow when submitting progress invoices. Values shown are for illustration purposes only. Provide actual project name and numbers, and name of Owner's representative on completed invoices. Variations from this format are acceptable where all of the information indicated below is provided.

.3 Invoice shall bear be printed on the Contractor's corporate letterhead or otherwise bear the Contractor's name, address, telephone number, HST registration numbers.

Project Coordinator
Name
Position Title
City Title
Address
City, ON POSTAL CODE

Project: City Title
Project Title
Consultant Project No. #####
Date:

Application for Payment No. XX

Contract Summary

1	Original *Contract Price* (excluding HST)	$100,000.00	
2	Change Orders	$2,000.00	
3	Current Value of Change Directives Certified	$0.00	
4	Value of *Contract Price* on last day of payment period (1+2+3)	$102,000.00	$102,000.00
5	*Value Added Taxes* @ 13%		$15,650.00
6	Total amount payable for the construction of the *Work* including Value Added Taxes (4+5)		$117,650.00

Payment Application Summary

7	Total Value Requested to be Certified	$45,000.00	
8	Total Holdback @ 10%	4,500.00	
9	Holdback Released	$0.00	
10	Current Holdback (8-9)	$4,500.00	
11	Amount (value of *Work* performed and products delivered to the Place of Work less holdback retained (7-10)	$40,500.00	$40,500.00
12	Less amount from previous certificate for payment	$15,000.00	
13	Amount of Contract Price invoiced for current period (11-12)	$25,500.00	$25,500.00
14	Value Added Taxes @ 13%	$3,315.00	$3,315.00
15	**Total Amount Invoiced including Value Added Taxes (13+14)**		**$28,815.00**

Invoice to be signed by Contractor

Name, credentials and position of person signing
attachments ***(WSIB, summary of change orders, contract price breakdown, substantiation for cash allowance expenditures, Statutory Declaration, etc.)***
Contractor's HST Registration No.: _____

Part 1 General

1.1 SECTION INCLUDES

.1 Pre-installation meetings.

1.2 RELATED SECTIONS

.1 Section 01 32 00 - Construction Progress Documentation.

.2 Section 01 33 00 - Submittal Procedures.

.3 This section describes requirements applicable to all Sections.

1.3 PROJECT COORDINATION

.1 Assume full responsibility for, and execute complete layout of Work to locations, lines and elevations indicated.

.2 Provide devices needed to lay-out and construct Work.

.3 Supply devices required to facilitate Consultant's review of Work.

.4 Each trade shall examine the Work upon which the trade or specification Section depends. Have all defects and deficiencies corrected prior to proceeding with Work. The application of Work or any part of it shall be deemed acceptance by the Contractor of the work upon which subsequent Work depends.

1.4 CONSTRUCTION ORGANIZATION AND PRE-CONSTRUCTION MEETING

.1 Within ten (10) days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Attend a start-up meeting before commencing Work. Purpose of meeting is to review procedures.

.3 Consultant will record and distribute minutes for the start-up meeting.

.4 Consultant, Owner, senior representatives of the Contractor, major Subcontractors, field inspectors and supervisors are to be in attendance.

.5 Establish time and location of meeting and notify parties concerned minimum five (5) days before meeting.

.6 Consultant to provide Agenda including but not limited to the following:

.1 Appointment of official representative of participants in Work.

.2 Schedule of Work, progress scheduling as specified in Section 01 32 00 – Construction Progress Documentation.

.3 Schedule of submission of shop drawings, samples, colour chips as specified in Section 01 33 00 – Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences as specified in Section 01 51 00 – Temporary Utilities.

.5 Site safety as specified in Section 01 35 23 – Health and Safety.

.6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements.

.7 Owner-furnished Products. (If applicable)

.8 Monthly progress claims, administrative procedures, photographs, and holdbacks.

.7 Submit, at this meeting, proof that application has been made to the Ministry of Labour for "Notice of Project" where legislation requires this notification be made. Work may not proceed until the Ministry has been notified.

.8 Submit prior to meeting construction schedule and schedule of values.

.9 Comply with Consultant's allocation of mobilization areas of site.

.10 During construction, coordinate use of site and facilities through Consultant's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.11 Comply with instructions of Consultant for use of temporary utilities and construction facilities.

.12 Coordinate field engineering and layout Work with Consultant.

.13 Consultant to preside at meeting, produce and distribute minutes for start-up meeting only.

1.5 PROJECT PROGRESS MEETINGS

.1 Schedule and administer bi-weekly Project progress meetings throughout progress of Work as determined by Consultant.

.2 Schedule and administer pre-installation meetings when specified in sections and when required to coordinate related or affected Work.

.3 Prepare agenda for meetings.

.4 Distribute written notice of each meeting four (4) days in advance of meeting date to Consultant and Owner.

.5 Sub-consultants and Sub-trades who have Work in progress or imminent at the time of the meeting shall attend Project progress meetings.

.6 Provide physical space and make arrangements for meetings.

.7 Preside at meetings.

.8 Record minutes. Include significant proceedings and decisions. Identify action by parties.

.9 Reproduce and distribute copies of minutes within three (3) days after each meeting and transmit to meeting participants, affected parties not in attendance, Owner and Consultant.

.10 Agenda to include:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Progress schedule, during succeeding Work period.

.4 Field observations, problems, conflicts.

.5 Problems which impede construction schedule.

.6 Review of off-site fabrication delivery schedules.

.7 Corrective measures and procedures to regain projected schedule.

.8 Revision to construction schedule.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for effect on construction schedule and on completion date.

.12 Review site safety and security issues.

.13 Other business.

1.6 ON-SITE DOCUMENTS

.1 Contractor is responsible to print and maintain at job site, in good order and available to the Owner and the Consultant, one copy each of the following:

.1 Approved building permit drawings and permit cards

.2 Contract drawings.

.3 Specifications.

.4 Addenda.

.5 Additional written instruction that change this Work and supplement the Contract.

.6 Reviewed shop drawings and other submittals.

.7 Construction Progress schedule, Meeting minutes

.8 Supplemental Instructions (SI) and Request for Information (RFI)

.9 Change Orders and Proposed Changes.

.10 Other modifications to Contract.

.11 Field Inspection and test reports by testing and inspection agencies.

.12 Copy of approved Work schedule.

.13 Manufacturers' installation and application instructions, and certifications

.14 Labour conditions and wage schedules.

.15 Applicable current editions of municipal regulations and by-laws. Current building codes, complete with addenda bulletins applicable to the Place of the Work. Include permits inspection certificates and other documents required by authorities having jurisdiction.

.16 Copy of each of the Consultant’s site visit reports and records of meetings.

.17 Current as-built drawings

.18 MSDS for all controlled products.

1.7 SCHEDULES

.1 Submit preliminary construction progress schedule as specified in Section 01 32 00 – Construction Progress Documentation to Consultant coordinated with Consultant's Project schedule.

.2 After review, revise and resubmit schedule to comply with revised Project schedule.

.3 During progress of Work revise and resubmit as directed by Consultant.

1.8 SUBMITTALS

.1 Prepare and issue submittals to Consultant for review.

.2 Submit preliminary Shop Drawings, Product data and samples as specified in Section 01 33 00 – Submittals Procedures for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Consultant.

.3 Submit requests for payment for review, and for transmittal to Consultant.

.4 Submit requests for interpretation of Contract Documents, and obtain instructions through Consultant.

.5 Process substitutions through Consultant.

.6 Process change orders through Consultant.

.7 Deliver closeout submittals for review and preliminary inspections, for transmittal to Consultant.

1.9 CLOSEOUT PROCEDURES

.1 Notify Consultant in writing when Work is considered ready for Substantial Performance.

.2 Accompany Consultant on preliminary inspection to determine items listed for completion or correction.

.3 Comply with Consultant's instructions for correction of items of Work listed in executed certificate of Substantial Performance.

.4 Notify Consultant of instructions for completion of items of Work determined in Consultant's final inspection.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Schedules, form, content, submission.

.2 Construction Progress scheduling.

.3 Progress photographs.

.4 Submittals schedule.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 All other Division 01 Specification Setions.

.3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 SUMMARY

.1 This Section specifies Contractor's responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.

.2 The purpose of submitting progress schedules is to:

.1 Inform Owner and Consultant of actual progress versus planned progress, and

.2 provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.4 CONSTRUCTION PROGRESS SCHEDULE

.1 Submit initial schedule in duplicate within ten (10) days after date of award of Contract.

.2 Submit schedule via e mail as .pdf files.

.3 Consultant will review format and content of initial schedule and request necessary changes, if any, within five (5) Working Days after receipt.

.4 If changes are required, resubmit finalized initial schedule within five (5) Working Days after return of review copy.

.5 Revise and resubmit as required.

.6 Submit updated progress schedule bi-weekly to Owner and Consultant, indicating actual and projected start and finish dates with report date line and progress, and baseline comparison to current progress.

.7 Format and Context of Construction Progress Schedule:

.1 Submit a horizontal bar/Gantt chart with separate line for each section of Work, identifying first Work day of each week.

.2 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

.3 Provide a separate horizontal progress bars for projected base line and actual progress line for each item.

.4 Split progress line horizontally for projected and actual performance.

.5 Indicate estimated percentage of completion for each item of Work at each submission.

.6 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.

.7 Include dates for commencement and completion of each major element and milestone dates of construction.

.1 Site clearing.

.2 Mobilization.

.3 Site utilities

.4 Start/Completion of phased Work (if appropriate).

.5 Foundation Work.

.6 Structural framing.

.7 Special Subcontractor Work.

.8 Equipment Installations.

.8 Finishes.

.9 Substantial Performance

.10 Ready-for-Takeover

.11 Deemed Total Completion.

.12 Indicate progress of each activity to date of submission schedule.

.13 Indicate changes occurring since previous submission of schedule:

.1 Major changes in scope.

.2 Activities modified since previous submission.

.3 Revised projections of progress and completion.

.4 Other identifiable changes.

.14 Provide a narrative report to define:

.1 Problem areas, anticipated delays, and impact on schedule.

.2 Corrective action recommended and its effect.

.3 Effect of changes on schedules of other prime contractors.

1.5 SUBMITTAL SCHEDULE

.1 Include schedule for submitting shop drawings, product data, samples and mock up.

.2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.

.3 Include dates when delivery will be required for Owner-supplied Products.

.4 Include dates when reviewed submittals will be required from Consultant.

.5 Format:

.1 Prepare schedule in electronic format.

.2 Provide a separate line for each required submittal, organized by Specifications section names and numbers, and further broken down by individual Products and systems as required.

.3 Fore each required submittal, show planned latest date for return of reviewed submittal without causing delay.

.4 Allow time in schedule for resubmission of submittals, should resubmission be necessary.

.6 Submission of Schedule:

.1 Submit initial schedule to Consultant within fifteen (15) Working Days after Contract award.

.2 Submit schedule via e-mail in .pdf format.

.3 Consultant will review format and content of initial schedule and request necessary changes, if any, within five (5) Working Days after receipt.

.4 If changes are required, resubmit finalized schedule within five (5) Working Days after return of review copy.

.5 Submit updated submittals schedule at progress meeting to Owner and Consultant.

.6 Submit revised progress schedule with each application for payment.

.7 Distribute copies of revised schedule to:

.1 Job site office.

.2 Subcontractors.

.3 Other concerned parties.

.8 Instruct recipients to report to Contractor within five (5) days, any problems anticipated by timetable shown in schedule.

1.6 SCHEDULE MANAGMENT

.1 A schedule submitted as specified and accepted by Consultant shall become the baseline schedule and shall be used as the baseline for updates.

.2 At each regular progress meeting, review and discuss current construction progress and submittals schedules with Consultant and Owner, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.

.3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

1.7 AS-BUILT (REDLINE) DRAWINGS AND SPECIFICATIONS

.1 Contractor to maintain one set of construction drawings and specifications on site for recording deviations from the contract documents caused by site conditions and changes ordered by the consultant (red line mark-ups).

.1 Record locations of: concealed components of mechanical and electrical services; depths of various elements of foundations in relation to first floor; accurate location, depth, size and type of outside underground utilities; location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features or structure; field changes of dimension and details; changes made by Change Order, Change Directive or Supplemental Instruction.

.2 Mark up specifications to record actual construction, including manufacturer, trade name, and catalogue number of each item actually installed, particularly alternative, optional and substitute items.

.3 Annotations are to be made as construction progresses.

1.8 RECORDING ACTUAL SITE CONDTIONS ON AS-BUILT DRAWINGS

.1 Obtain from Consultant an electronic copy of the construction Drawings for the purpose of creating as-built drawings. Record information in electronic form or hard copy, clearly identifying as-built deviations from the originally obtained construction Drawings.

.2 Clearly label each drawing as “AS-BUILT DRAWING”. Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.3 Record deviations from the contract documents caused by site conditions and changes ordered by the Consultant including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.

.4 Prepare and issue submittals to Consultant for review.

.5 Submit preliminary Shop Drawings, Product data and samples [as specified in Section 01 33 00 – Submittals Procedures] for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Consultant.

.6 Submit requests for payment for review, and for transmittal to Consultant.

.7 Field changes of dimension and detail.

.8 Changes made by Change Orders and Supplemental Instructions

.9 References to Shop Drawings, where Shop Drawings show more detail.

.4 Do not use as-built drawings for construction purposes.

.5 Provide Redline (As-built) drawings required by Consultant for preparation of Record Drawings.

.6 Renew and approve Red-line (As-built) drawings for Submittal to Consultant.

1.9 RECORDING ACTUAL SITE CONDTIONS ON AS-BUILT SPECIFICATIONS

.1 Obtain from Consultant an electronic copy of the construction Specifications for the purpose of creating as-built specifications. Record information in electronic form or hard copy, clearly identifying as-built deviations from the originally obtained construction specification.

.2 Clearly label each specification as “AS-BUILT SPECIFICATION”. Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.3 Record deviations from the contract documents caused by site conditions and changes ordered by the Consultant including:

.1 Changes made by Change Orders, Change Directive, and Supplemental Instructions

.2 References to Shop Drawings, where Shop Drawings show more detail and modifications.

.4 Do not use as-built Specification for construction purposes.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: Maintain manufacturer's certifications, field test records, inspection certifications required by individual specifications sections.

1.10 DAILY LOG

.1 Contractor is to maintain on site daily logs.

.2 Daily logs to include:

.1 Name, job title, # hours works, and work undertaken for all personnel on site,

.2 General progress of work for that day,

.3 Name, title, and reason for site access of all non-contracted personnel.

.4 An address directory recording the names, address and telephone number of the representative of all subcontractors, trades and suppliers doing Work or supplying material for project.

.5 Record briefly various items of Work being carried out on each day including the number of workers and amount of Work completed.

.6 Record ordering dates and receiving dates of material F.O.B. job site to the site.

.7 Record accidents and first aid given.

.3 Daily log shall be open to review by the Consultant and by the City. Upon request, provide copy of log to City or Consultant.

1.11 PROGRESS PHOTOGRAPHS

.1 Arrange for periodic digital photography to document and provide a photographic record of the progress of the Work.

.2 Digital Photography

.1 Submit electronic copy of colour digital photography in *JPEG format, minimum 4 megapixels resolution.

.2 Identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints: [two (2)] [four (4)]. Location of viewpoints determined by Consultant.

.4 Frequency: As directed by Consultant/

.5 Do not use progress or any other Project photographs for promotional purposes without Owner's written consent.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Shop drawings and product data.

.2 Samples.

.3 Certificates and transcripts.

1.2 RELATED SECTIONS

.1 Section 01 32 00 – Construction Progress Documentation

.2 Section 01 78 10 – Closeout Submittals

.3 Other sections requesting submittals.

.4 This section describes requirements applicable to all Sections.

1.3 ADMINISTRATIVE

.1 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.

.3 Work affected by submittal shall not proceed until review is complete.

.4 Present Shop Drawings, product data, samples and mock-ups in IP (imperial inch-pound) units.

.5 Where items or information is not manufactured or produced in IP imperial units, converted values within the measurement tolerances are acceptable.

.6 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.

.7 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.

.8 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.9 Verify field measurements and affected adjacent Work are coordinated.

.10 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.

.11 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.12 Keep one (1) reviewed copy of each submission on site.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow five (5) days for Consultant's review of each submission.

.4 Adjustments made on Shop Drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

.5 Make changes in Shop Drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revisions other than those requested.

.6 Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.7 Submissions shall include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor’s stamp, date and signature of Contractor’s authorized representative responsible for Shop Drawing review, indicating that each shop drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to other parts of the Work.

.8 After Consultant's review, distribute copies.

.9 Submit electronic copy of Shop Drawings for each requirement requested in specification Sections and as consultant may reasonably request.

.10 Submit electronic copy of product data sheets or brochures for requirements requested in specification sections and as requested by Consultant where Shop Drawings will not be prepared due to standardized manufacture of product.

.11 Delete information not applicable to project.

.12 Supplement standard information to provide details applicable to project.

.13 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.14 Consultant’s notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant’s notation to be a change in the Work, promptly notify the Consultant in writing before proceeding with the work.

.15 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the Work proceeds. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.

1.5 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Consultant's business address.

.3 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

.6 Make changes in samples which Consultant may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.6 PRELIMINARY SUBMITTAL AND MOCK-UP CHECKLIST

** Note: This is a preliminary checklist additional submittals may be noted in the Architectural, Structural, Mechanical, Electrical and Landscape specifications and drawings.*

Timing	Item	Description of Submittal	Specification Reference No.
1.0 With Bid	1.1	Bid Form	Bid Form
	1.2	Addenda Inclusion	Bid Form
	1.3	Tender Price Schedule with List of Sub trades/Suppliers	Bid Form
	1.4	Separate, Itemized & Alternate Prices	Bid Form
	1.5	Other documentations per city requires	Bid Form
2.0 Before Signing	2.1	Bonds and insurance	G.C. 8
3.0 1 week After Signing	3.1	Construction Progress Schedule	G.C. 3.5 / 01 32 00
4.0 2 weeks After Signing	4.1	Schedule of Values	G.C. 5.3/ 01 22 10
	4.2	Submittal Schedule	01 32 00
	4.3	Scaffolding	01 54 23
5.0 Prior to Mobilization	5.1	Health and Safety Plan	01 35 23
6.0 To Accommodate Construction Schedule	6.1	Refer to list of submittal, samples, mock up, shop dwg, etc under each section for Architectural, Structrual, Mechanical, Electrical and Landscape.	All sections.
7.0 Close-Out	7.1	Operating and Maintenance Manuals	01 78 10
	7.2	Red-line as-built drawings	01 78 10
	7.3	Warranty and Bonds	01 78 10

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Safety requirements and adherence.

1.2 RELATED SECTIONS

.1 Section 01 31 00 - Project Managing and Coordination.

.2 Section 01 33 00 - Submittal Procedures.

.3 This section describes requirements applicable to all Sections.

1.3 REFERENCES

.1 Province of Ontario: Occupational Health and Safety Act, Regulation and Code R.S.A -Amended 1995, including requirements for a "Prime Contractor" as defined by the Act.

1.4 SAFETY PLAN

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.5 RESPONSIBILITY

.1 The "Prime Contractor" according applicable local jurisdiction, is responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

.3 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, and follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction. Advise Consultant verbally and in writing.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation.

.3 Submit electronic copy of Contractor's authorized representative's Work Site Health and Safety Inspection Reports to Consultant upon request.

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit Material Safety Data Sheets (MSDS) to Consultant.

.7 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within five (5) days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within five (5) days after receipt of comments from Consultant.

.8 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 Medical Surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Consultant.

.10 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

.11 File Notice of Project with Provincial authorities prior to commencement of Work.

1.7 SAFETY ACTIVITIES

.1 Perform site specific safety hazard assessment related to project.

.2 Schedule and administer Health and Safety meeting with Consultant prior to commencement of Work.

.3 Perform Work in accordance with Section 01 41 00 - Regulatory Requirements and this Section.

1.8 HEALTH AND SAFETY COORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:

.1 Have working knowledge of occupational safety and health regulations.

.2 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.4 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.9 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant.

1.10 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Consultant.

.2 Provide Consultant with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Consultant may stop Work if non-compliance of health and safety regulations is not corrected.

1.11 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Lead paint.

1.12 HAZARDOUS WORK

.1 Blasting or other use of explosives is not permitted.

1.13 HAZARDOUS MATERIALS

.1 Hazardous materials shall not be introduced for experimental or any other use prior to being evaluated by the Consultant.

.2 Make known and hazardous materials to be used and method of application before using. Be responsible for storage and proper safety requirements.

1.14 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

1.15 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

.2 Provide fire extinguishers as required by the stricter of the Occupational Health and Safety Act and regulations made thereunder, and the Ontario Fire Code.

.3 Burning rubbish and construction waste materials is not permitted on site.

.4 Maintain placed or installed fire resistive construction to protect the portions of the Work during construction.

.5 Particular attention shall be paid to the elimination of fire hazards.

.6 Take all necessary precautions to prevent fire, and to prevent damage to buildings, materials, personnel, equipment, furnishings and chattels.

.7 Flammable Liquids:

.1 Flammable liquids are to be kept to a minimum and shall be stored in approved safety containers. Obtain Owner prior approval for storing flammable and combustible liquids in occupied buildings.

1.16 COMPRESSED GAS OR EXPLOSIVE – ACTUATED FASTENER TOOLS

.1 Use explosive-actuated and compressed gas fastener tools only under strictest safety conditions. Keep equipment locked in storage cabinet unless in active use by personnel. Equipment shall not be left unattended, or be accessible to anyone other than authorized user.

Part 2 Products (Not Used)

Part 3 Products (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Laws, notices, permits and fees.

.2 Discovery of [hazardous materials].

1.2 RELATED SECTIONS

.1 Hazardous material abatement.

.2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 LAWS, NOTICES, PERMITS AND FEES

.1 The laws of the Place of the Work shall govern the Work.

.2 The Owner shall obtain and pay for the building permit, permanent easements and rights of servitude. The Contractor shall be responsible for permits, licenses or certificates necessary for the performance of the Work which were in force at the date of executing the Agreement.

.3 Give the required notices and comply with the laws, ordinances, rules, regulations or codes which are or become in force during the performance of the Work and which relate to the Work, to the preservation of the public health and to construction safety.

.4 If the Contractor knowingly performs or allows work to be performed that is contrary to any laws, ordinances, rules, regulations or codes, the Contractor shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations or codes.

.5 Determine detailed requirements of authorities having jurisdiction.

.6 Pay construction damage deposits levied by municipality in connection with the issuance of a building permit.

1.4 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: If material resembling asbestos is encountered in course of demolition work, immediately stop work and notify Consultant.

.2 Refer to Division 2 for asbestos abatement.

1.5 PERSONNEL SMOKING

.1 Comply with regulatory and Owner imposed smoking restrictions during execution of the Work within or outside the premises.

Part 2 **Products** (Not Used)

Part 3 Products (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Quality assurance criteria.

1.2 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control.

.2 This section describes requirements applicable to all Sections.

1.3 REFERENCES

.1 AABC (Associated Air Balance Council): National Standards For Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems.

1.4 QUALITY ASSURANCE

.1 Provide testing organization services as specified in Section 01 45 00 – Quality Control.

.2 Testing organization: Current member in good standing of their respective professional or industry organization and certified to perform specified services.

.3 Comply with applicable procedures and standards of the certification sponsoring association.

.4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

.5 Qualifications:

.1 Provide adequate workforce training through meetings and demonstrations.

.2 Have someone on site with deconstruction experience throughout project for consultation and supervision purposes.

1.5 QUALITY OF WORK

.1 Work shall be of the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit persons or anyone unskilled in their required duties.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the consultant, whose decision is final.

.4 All Contractor personnel are restricted to the job site and necessary access routes. No personnel shall visit other areas or building without specific authorizations.

.5 Pre-qualified subcontractors named in the Contractor's Bid Form shall be engaged for Work of this Contract including and not limited to preforming required mock-ups and overseeing of associated Work. Contractor to submit list of names as per Bid form for Consultant's review.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mock-ups.

.4 Mill tests.

.5 Written and electronic reports.

.6 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

.1 Section 01 21 00 - Allowances.

.2 Section 01 43 00 - Quality Assurance.

.3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

.1 “Reference standards” means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.

.2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.

.3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.

.4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.

.5 Within the Specifications, reference may be made to the following standards writing, testing, or certification organizations by their acronyms or initialisms:

.1 AA Aluminum Association

.2 ACI American Concrete Institute

.3 AISC American Institute of Steel Construction

.4 ANSI American National Standards Institute

.5 ASME American Society of Mechanical Engineers

.6 ASTM American Society for Testing and Materials

.7 AWMAC Architectural Woodwork Manufacturers Association of Canada

.8 AWPA American Wire Producers Association
.9 CaGBC - Canadian Green Building Council
.10 CGSB Canadian General Standards Board
.11 CISC Canadian Institute of Steel Construction
.12 CPCI Canadian Prestressed Concrete Institute
.13 CSA Canadian Standards Association
.14 CSSBI Canadian Sheet Steel Building Institute
.15 CWB – Canadian Welding Bureau
.16 ICEA Insulated Cable Engineers Association
.17 IEEE Institute of Electrical and Electronics Engineers
.18 IGMAC – Insulating Glass Manufacturers Association of Canada
.19 ISO/IEC 17025-2005 - General Requirements for the Competence of Testing and Calibration Laboratories.
.20 LEED - Leadership in Energy and Environmental Design
.21 MPP – Master Painters Institute
.22 MSS Manufacturers Standardization Society of the Valve and Fittings Industry
.23 NAAMM National Association of Architectural Metal Manufacturers
.24 NEMA National Electrical Manufacturers Association
.25 NFPA National Fire Protection Association
.26 NHLA National Hardwood Lumber Association
.27 NLGA National Lumber Grades Authority
.28 SCC (Standards Council of Canada)
.29 SSPC – The Society for Protective Coatings
.30 TTMAC Terrazzo, Tile and Marble Association of Canada
.31 ULC Underwriters' Laboratories of Canada

1.4 INSPECTION BY AUTHORITY

.1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 The Contractor shall arrange all inspections required by Authority(s) Having Jurisdiction.

.3 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.

.4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.5 Where Owner and Consultant feels it necessary, for any reason whatsoever, the Owner and Consultant may also arrange for the Authority(s) Having Jurisdiction to attend at the Work site.

1.5 REVIEW BY CONSULTANT

.1 Consultant may order any part of the Work to be reviewed or inspected if Work is suspected to be not in accordance with Contract Documents.

.2 If, upon review such work is found not in accordance with Contract Documents, correct such Work and pay cost of additional review and correction.

.3 If such Work is found in accordance with Contract Documents, Owner will pay cost of review and replacement.

1.6 INDEPENDENT INSPECTION AGENCIES

.1 Except as otherwise specified, Owner will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the Work.

.2 Cost of such services will be borne by Owner.

.3 Retain and pay for inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.

.4 Section 01 21 00 – Allowances specifies a cash allowance for independent inspection and testing services to be retained and paid for by Contractor. Cash allowance excludes any inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.

.5 Employment of inspection and testing agencies by Contractor or Owner does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.

.6 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off site manufacturing and fabrication plants.

.7 For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies with timely notification in advance of required inspection and testing.

.8 Submit test samples required for testing.

.9 Provide labour, Construction Equipment and temporary facilities to obtain and handle test samples on site.

.10 Testing Organizations: Listed by SCC within info.palcan@scc.ca listings.

.11 Employment of inspection and testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.12 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Owner. Pay costs for retesting and re-inspection.

1.7 INSPECTION AND TESTING AGENCY REPORTS

.1 For inspection and testing required by Contract Documents or by regulatory requirements, and performed by Contractor retained inspection and testing

agencies, submit to Consultant and Owner one (1) copy of reports. Submit within 5 days after completion of inspection and testing.

.2 For inspection and testing performed by Owner retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to Contractor.

1.8 ACCESS TO WORK

.1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Cooperate to provide reasonable access and facilities for such access.

.3 Contractor's Responsibilities:

.1 Contractor's Responsibilities

.1 Provide equipment required for executing inspection and testing by appointed agencies. Facilitate inspections and tests.

.2 Co-ordinate with, and supply all materials for inspection and testing purposes as requested by the inspection and testing company.

.3 Make good work disturbed by inspection and testing.

.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

1.9 PROCEDURES

.1 Notify appropriate agency [and Consultant] in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.10 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price the difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Consultant.

1.11 REPORTS

.1 Submit [one (1) electronic copy of signed inspection and test reports to Consultant.

.2 Provide signed paper copies to manufacturer or fabricator of material being inspected or tested.

1.12 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Consultant and may be authorized as recoverable.

1.13 MOCK-UPS

.1 Prepare mock-ups of Work as specified in the technical Specifications. Include for Work of all Sections required to provide mock-ups.

.2 No Work is to proceed prior to Consultant's approval.

.3 Construct in all locations [as specified in specific Section. Where location is not specified, obtain direction from Consultant. Mock-up location to be identified through visual means [area to be taped off].

.4 Prepare mock-ups for Consultant's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.5 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.6 Modify mock-up as required until Consultant approval is obtained.

.7 If requested, Consultant will assist in preparing a schedule fixing dates for preparation.

.8 Entire mock-up to be removed if not followed prescribed procedure.

.9 Approved mock-ups establish an acceptable standard for the Work.

.10 Approved mock-up may remain as part of Work at Consultant's discretion.

.11 Where mock-up(s) are not incorporated into the Work, remove mock-up at conclusion of Work or when acceptable to Consultant. Repair any damage and clean-up at place of mock-up.

.12 Selected mock-ups to be performed in front of Consultant.

.13 Protect mock-ups from damage until the Work they represent is complete.

.14 Mock-ups to be carried out by assigned pre-qualified Subcontractor who performs mock-up must carry out and oversee associated Work.

1.14 MILL TESTS

.1 Submit mill test certificates as required of specification Sections.

1.15 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical [and building equipment] systems.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Service and utility systems

.2 Water supply

.3 Temporary heating and ventilation

.4 Temporary power and light

.5 Temporary communication facilities

1.2 RELATED SECTIONS

.1 Section 01 52 00 - Construction Facilities.

.2 Section 01 53 00 - Temporary Construction.

.3 Section 01 57 00 – Temporary Control

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Salvage and assist in recycling products for potential reuse.

.3 Remove from site all such work after use.

.4 This section describes requirements applicable to all Sections.

1.4 SERVICE AND UTILITY SYSTEMS

.1 Consult with utility companies and other authorities having jurisdiction to ascertain the locations of existing services on or adjacent to site.

.2 Information as to the location of existing services, if shown on the Drawings, does not relieve the Contractor of his responsibility to determine the exact number and location of existing services.

.3 Give proper notices for new services as may be required. Make arrangements with authorities and utilities for service connections required.

.4 Pay any charges levied by utilities or authorities for work carried out by them in connection with this Contract, unless specified otherwise.

.5 Report existing unknown services encountered during excavation to Consultant for instructions; cut back and cap or plug unused services. Be responsible for the protection of all active services encountered and for repair of such services if damaged.

1.5 WATER SUPPLY

.1 Owner will provide continuous supply of potable water for construction use.

.2 Provide and maintain all temporary lines, extensions and hoses as required. Remove all temporary connections and lines on completion of the Work and make good any damage.

1.6 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.

.3 Provide temporary heat and ventilation in enclosed areas as required to:

- .1 Facilitate progress of Work.
- .2 Protect Work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.

.4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.

.5 Ventilating:

- .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.6 Permanent heating system of building, may not be used when available. Be responsible for damage to heating system if use is permitted.

.7 Ensure date of Substantial Performance of the Work and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Consultant.

.8 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

- .1 Conform with applicable codes and standards.
- .2 Enforce safe practices.
- .3 Prevent abuse of services.
- .4 Prevent damage to finishes.
- .5 Vent direct-fired combustion units to outside.

.9 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 TEMPORARY POWER AND LIGHT

.1 Provide a source for, and pay the costs of temporary power during construction for temporary lighting and operating of power tools.

.2 In the event where existing power source is inadequate for construction activities, Contractor to provide and make all necessary arrangements for any pay all costs for temporary electrical service of sufficient capacity to supply temporary lighting, operation of power tools, cranes and equipment for all construction, implementation and inspection and testing purposes. Supply and install necessary temporary cables and other electrical equipment and make all temporary connections as required.

.3 Temporary power distribution wiring shall comply with Ontario Hydro Electrical Safety Code. Obtain inspection certificates for temporary electrical work.

.4 Contractor to provide and pay costs of temporary power required when Building Service interruptions are required due to construction.

.5 Provide and maintain temporary lighting throughout project.

.6 Supply and install the type and quantity of minimum lighting equipment in each location to ensure adequate, continual illumination 24 hours per day, 7 days per week for the following:

.1 Emergency evacuation, safety and security throughout the Project at intensity levels required by jurisdictional authorities.

.2 General lighting for performance of the Work throughout the Project, evenly distributed, and at intensities to ensure that proper installations and applications are achieved.

.3 Performance of finishing trades in area as required evenly distributed, and of an intensity of at least 50 Lux.

.7 Upon Contract Completion, remove electrical plant and temporary lighting from the Site.

1.8 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for temporary telephone, data hook up, line/lines and equipment necessary for own use and use of Consultant.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Construction parking.

.3 Vehicle access.

.4 Security

.5 Office

.6 Site storage and over loading

.7 Sanitary Facility

.8 Discovered Valuables

.9 Fire Protection

.10 Project identification.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities.

.2 Section 01 53 00 – Temporary Construction.

.3 Section 01 54 23 – Temporary Scaffolding and Platforms

.4 Section 01 57 00 – Temporary Controls

.5 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 CONSTRUCTION FACILITIES - GENERAL

.1 Provide temporary construction facilities as necessary for performance of the Work and in compliance with applicable regulatory requirements.

.2 Maintain temporary construction facilities in good condition for the duration of the Work.

.3 Remove temporary construction facilities from Place of the Work when no longer required.

1.4 SCAFFOLDING

.1 Provide and maintain ladders, platforms, scaffolding, swing staging, temporary stairs, and ramps.

1.5 HOISTING

.1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Cranes and Hoists shall be operated by qualified operator.

1.6 USE OF THE WORK

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with Products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.7 CONSTRUCTION PARKING

.1 Limited parking will be permitted at Place of the Work for maximum 2 spaces. Provided it does not disrupt continuing operation of the facility and does not disrupt performance of Work.

.2 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.8 VEHICULAR ACCESS

.1 Provide and maintain adequate access to Place of the Work.

.2 Provide snow removal during period of Work.

.3 Existing roads at Place of the Work may be used for access to Place of the Work, provided Contractor assumes responsibility for any damage caused by construction traffic, and prevents or promptly cleans up any mud tracking or material spillage.

.4 Clean runways and taxi areas where used by Contractor's equipment.

1.9 SECURITY

.1 Comply with Owner’s policy and practices regarding site and building security. Do not reduce level of security afforded to building and site by Work of this Contract.

.2 The Contractor is responsible for arranging access for all workers and sub-contractors.

.3 Ensure all doors are locked and secured prior to leaving the site.

1.10 OFFICES

.1 Provide trailer office complete with lighting, heating and air conditioning equipment to maintain to 21 degrees C. Office shall be sufficient size to accommodate site meetings for minimum of 8 people and furnished with table and chairs.

.2 Provide a telephone, computer, fax/printer and internet. The computer is to have internet access and be capable of sending/receiving documents;

.3 Provide a clearly marked and fully stocked first-aid case in a readily available location.

1.11 SITE STORAGE AND OVER LOADING

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

.3 Product shall be stored only in areas designated or approved by the Consultant, and shall not be left lying on streets, sidewalks, boulevards or elsewhere within public view. Products which the Consultant may permit to be stored elsewhere than in the Contractor's storage areas shall be neatly stacked or otherwise disposed and shall be so maintained.

.4 Fabrication shops shall not be set up within the structure except as directed by or with the permission of the Consultant.

.5 Do not load or permit to be loaded any part of the Work with a weight or force that it is not calculated to bear safely. Be solely responsible and liable for damages resulting from violation of this requirement. Provide temporary supports as strong as permanent support.

.6 Site storage and loading requirements to be in accordance with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

1.12 SANITARY FACILITIES

.1 GC to provide own sanitary facility. Post notices and take such precautions as required by local health authorities.

.2 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.3 Keep sanitary facilities clean and fully stocked with the necessary supplies at all times.

1.13 DISCOVERED VALUABLES

.1 All articles, such as relics, antiquities, or items of historical or scientific interest which may be discovered during demolition, dismantling, or excavation of the place of Work are the property of the Owner and shall be immediately delivered into the custody of the Owner.

1.14 FIRE PROTECTION

.1 Provide and maintain temporary fire protection systems and equipment during construction.

.2 Provide fire extinguishers of the non-freezing chemical type in Garage and each temporary building, enclosure and trailer. Use only fire-proofed tarpaulins.

.3 Excessive storage of flammable liquids and other hazardous materials is not allowed on Site. Flammable liquids must be handled in approved containers. Remove combustible waste frequently.

.4 Inspect temporary wiring, drop cords, extension cables for defective insulation or connections frequently.

.5 Open burning of rubbish is not permitted on the Site.

.6 Handle, transport, store, use and dispose of gasoline, benzene or other flammable materials with good and safe practice as required by authorities having jurisdiction.

.7 A fire watch shall be required for each of the following activities regardless of the number, duration or size of the activity in operation:

.1 Any open flame activities (eg., soldering and welding)'

.2 Shutdown of fire detection system;

1.15 PROJECT IDENTIFICATION SIGN

.1 Project identification sign to be of wood frame and plywood construction with graphics produced by a professional sign company. Signage size to be discussed with Owner.

.2 No other signs or advertisements, other than safety, warning, or directional signs, are permitted without Consultant's prior approval.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Site enclosure.

.2 Guardrails and barriers.

.3 Dust tight barriers.

.4 Protection for off-site and public property.

.5 Protection of applied finishes and equipment

.6 Protection of surrounding Work.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities.

.2 Section 01 52 00 – Construction Facilities

.3 Section 01 57 00 – Temporary Control

.4 This section describes requirements applicable to all Sections.

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.4 SITE ENCLOSURE

.1 Erect and maintain pedestrian walkways adjacent to the site.

.2 Erect temporary site enclosure using new 8 feet high, freestanding, temporary welded wire fencing panels.

.1 Maintain fence in good repair.

.2 Provide a lockable gates through fencing.

.3 Prevent unauthorized entry to the Site. Barricade, guard or lock access points to the satisfaction of the Owner and Consultant and post "NO TRESPASSING" signs.

.4 Install signs for movement of people around Work Site as required and directed by Owner and Consultant.

.3 Remove fencing, barriers, building enclosures, guide rails and barricades upon Contract Completion

1.5 GUARD RAILS AND BARRIERS

.1 Provide as required by governing authorities.

.2 Snow fencing is not allowed as protection for sidewalk.

.3 Provide secure, rigid guide rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs as required for protection of Work, workers, and the public.

.4 Provide secure barricades around Stables from damages resulted from vehicle and construction process.

1.6 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Design enclosures to withstand wind pressure and snow loading.

1.7 DUST TIGHT BARRIERS

.1 Provide dust tight barriers and screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.9 PROTECTION OF APPLIED FINISHES AND EQUIPMENT

.1 Provide protection for finished and partially finished surfaces and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Provide temporary weather tight, dust tight and lockable partitions where work is preformed. Provide weather tight closures to unfinished door and window openings, top of shafts and other openings in floors, walls and roofs.

.4 Equipment and existing work moved or altered to facilitate construction, movement of Products or equipment shall be stored, protected with dust-tight covers and subsequently returned to its original location.

.5 Protect finished surfaces of new work from damage by restriction of access or by use of physical means suitable to the material and surface location. Where construction operations must be performed or traffic routed over finished floors, lay 6 mm plywood coverings tightly fitted and secured over surface in such areas.

.6 Any Products or equipment damaged while carrying out the Work shall be restored with new Products or equipment matching the original equipment. Damage shall include harm resulting from all construction work, such as falling objects, wheel and foot traffic, failure to remove debris, operation of machinery and equipment, and scaffolding and hoisting operations.

.7 Be responsible for damage incurred due to lack of or improper protection.

1.10 PROTECTION OF SURROUNDING WORK

.1 Provide protection for existing structures, finished and partially finished building finishes, waterproofing systems and equipment during performance of the Work.

.2 Provide protection for finished and partially finished Work from damage.

.3 Provide necessary cover and protection.

.4 Be responsible for damage incurred due to lack of or improper or inappropriate protection.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities

.2 Section 01 53 00 Temporary Construction.

.3 The requirements of this Section apply to all other Sections of the specifications.

1.2 GENERAL

.1 Scaffolding shall be the responsibility of the Contractor and shall not be transferred.

.2 Design, construction and maintenance of scaffolding system required for the convenient use of all contractors and Consultant to provide access to all portions of the work and all surfaces of the Cenotaph. General Contractor will provide for complete cost of this section.

.3 Scaffolding shall stay in place until all final inspections by Consultant have been concluded and Consultant has given instructions in writing to remove scaffolding.

1.3 QUALITY ASSURANCE

.1 Work of this Section can only be performed by scaffolding companies experienced in working on designated heritage buildings.

1.4 SUBMITTALS

.1 Submit detailed shop drawings bearing seal and signature of professional engineer licensed to practice in Ontario. Engineer to have at least 5 years' experience designing scaffolding and hoists. Shop drawings to include for all aspects of the scaffold including hot and cold weather protection stair tower(s) and hoist(s).

.2 Submit engineer's design calculations, including loadings. Do not anchor scaffolding into existing structure.

.3 Shop drawings of scaffold to be submitted within two weeks of award of contract.

.4 Submit written approval from authorities having jurisdiction for scaffold design.

.5 Entire scaffolding system shall be inspected at the beginning of each one month period by qualified representatives of scaffold supplier, and a written report shall be provided to the Consultant within 48 hours.

.6 Product data on scaffold framing, accessories, decking and mesh.

.7 Submit engineer stamped drawings of any modifications to scaffolding a minimum of 2 weeks prior to requirement for said modifications.

1.5 DESIGN REQUIREMENTS

.1 Assume complete design responsibility for scaffolding system and all associated elements such as stairs, hoists, guardrails, and enclosures.

.2 Comply with most current applicable requirements of:
- .1 CSA S269.2-M87 Access Scaffolding for Construction Purposes.
- .2 CAN/CSA-Z256-M87 Safety Code for Material Hoists.
- .3 Other regulatory requirements such as OHSA, Ministry of Labour, Workers' Compensation Board.

1.6 PERMITS

.1 Apply and pay for permits and security deposits.

1.7 USE OF SCAFFOLDING

.1 Use and maintain scaffolding in safe and secure manner, in accordance with applicable regulatory requirements. Modifications and maintenance are to be carried out by the scaffold supplier.

.2 Ensure that no part of scaffolding is subjected to loading that will endanger its safety, or the safety of the existing building.

.3 Scaffolding shall not be removed until all inspections have been carried out and deficiencies completed to the full satisfaction of the Consultant.

.4 If scaffolding is required bottom eight (8) ft. is to be encased in plywood. Scaffolding cannot be climbable.

1.8 FIELD QUALITY CONTROL

.1 Professional engineer responsible for design of scaffolding system shall visit site and inspect erected scaffolding immediately after its erection or modification and periodically thereafter but not less than once every 2 months and report his findings in writing with copy to Consultant.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 General.

.2 Site maintenance

.3 Public convenience and safety

.4 Utilities and services on premises

.5 Roads, curbs, gutters and walks

.6 Site visitors

.7 Snow removal

.8 Tree protection.

.9 Dewatering.

.10 Site drainage.

.11 Erosion and sediment control.

.12 Pollution (dust, debris, and noise) control.

1.2 RELATED SECTIONS

.1 Section

1.3 GENERAL

.1 Provide temporary controls as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.

.2 Maintain temporary controls in good condition for the duration of the *Work*.

.3 Remove temporary controls and *Construction Equipment* used to provide temporary controls from *Place of the Work* when no longer required.

1.4 SITE MAINTENANCE

.1 Maintain the Site and adjacent premises in a clean and orderly condition, free from debris and other objectionable matter. Immediately remove rubbish and surplus Products, equipment and structures from the Site. If the Site is not cleaned (within 48 hours after the Contractor has been instructed to do so), the Consultant may clean the Site and retain the cost from monies due, or to become due, to the Contractor.

.2 When the Work is substantially performed, remove surplus Products, tools, construction machinery and equipment not required for the performance of the remaining Work.

1.5 PUBLIC CONVENIENCE AND SAFETY

.1 Maintain sidewalks at and adjacent to the Site in a safe condition throughout the Contract. Promptly remove ice and snow.

.2 Keep haul routes free at all times from Products spilled on street surfaces and clean streets of deposits due to performance of the Work to the satisfaction of the Consultant and the highway and street authorities. Clean streets within 24 hours of Consultant's instruction.

.3 The Consultant may inspect haul routes, the Site and adjacent premises daily and may halt operations, withhold payment or carry out such additional operations as necessary, deducting the cost from monies due, or to become due, to the Contractor.

1.6 UTILITIES AND SERVICES ON PREMISES

.1 Verify limitations imposed on project work by presence of utilities and services, and ensure no damage occurs to them.

.2 Notify service authorities concerned so that they protect, remove, relocate, or discontinue them, as they may require.

.3 Make arrangements and pay for connection charges for services required for project work.

.4 Locate poles, pipes, conduit, wires, fill pipes, vents, regulators, meters, and sanitary services work in inconspicuous locations. If not shown on Drawings, verify location of service work with Consultant before commencing installation.

1.7 ROADS, CURBS, GUTTERS AND WALKS

.1 Include all curb cuts and making good of existing curbs, walks and paving on Municipal property to provide fully paved and finished approaches to requirements of authorities having jurisdiction.

1.8 SITE VISITORS

.1 During the progress of the Work, afford access to visitors duly authorized by the Consultant and facilitate inspections or tests they may desire to make. Record site visitors in log book maintained on site.

.2 Ensure Site visitors wear appropriate safety apparel.

1.9 SNOW REMOVAL

.1 Allow no accumulation of ice and snow on Site, and on roof deck when roofing operations are scheduled to take place.

.2 Remove snow from access road, Site circulation paths and elsewhere as required to permit access to Work, parking and uninterrupted construction progress.

1.10 TREE PROTECTION

.1 Refer to Arborist's Tree Protection Plan.

.2 In addition to Arborists' Tree Protection Plan, protect trees and other plant material designated to remain on site and on adjacent properties where indicated on *Drawings*.

.3 For trees designated to remain, protect roots inside dripline from disturbance or damage during excavation and grading. Avoid traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

1.11 DUST AND PARTICULATE CONTROL

.1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.

.2 Execute *Work* by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.

.3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

.5 Use appropriate covers on trucks hauling fine, dusty, or loose materials.

1.12 DEWATERING

.1 Provide temporary drainage and pumping as necessary to dewater excavations, trenches, foundations, and other parts of the *Work*. Maintain such areas free of water arising from groundwater or surface run-off, as required to keep them stable, dry, and protected from damage due to flooding.

.2 Maintain standby equipment necessary to ensure continuous operation of dewatering system.

.3 Do not pump water containing suspended materials or other harmful substances into waterways, sewers or surface drainage systems. Treat or dispose of such water in accordance with applicable regulatory requirements

1.13 SITE DRAINAGE

.1 Maintain grades to ensure proper site drainage.

.2 Prevent surface water runoff from leaving the site by site grading

.3 Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at end of each *Working Day*.

.4 Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas as required to prevent erosion and sedimentation.

.5 Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.

1.14 EROSION AND SEDIMENT CONTROL

.1 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and watercourses, and repair damage caused by soil erosion and sedimentation.

.2 Provide and maintain appropriate temporary measures such as silt fences, straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other measures that may be required to prevent erosion and migration of silt, mud, sediment, and other debris.

.3 Do not disturb existing embankments or embankment protection.

.4 Periodically inspect erosion and sediment control measures to detect evidence of erosion and sedimentation. Promptly take corrective measures when necessary.

.5 If soil and debris from site accumulate in ditches or other low areas, remove accumulation and restore area to original condition.

1.15 POLLUTION (DUST, DEBRIS AND NOISE) CONTROL

.1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.

.2 Execute *Work* by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.

.3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

.5 Use appropriate covers on trucks hauling fine, dusty, or loose materials.

.6 Arrange and pay for removal of all waste generated by the work in manner acceptable to authorities having jurisdiction.

.7 Limit noise levels in accordance with requirements of authorities having jurisdiction.

.8 Maintain temporary erosion and pollution control features installed under this contract.

.9 Control emissions from equipment and plant to local authorities emission requirements.

.10 Prevent abrasive-blasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures

.11 Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.

.12 Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur. Promptly report spills and releases that may occur to:

.1 authority having jurisdiction,

.2 person causing or having control of pollution source, if known, and

.3 *Owner* and *Consultant*.

.14 Contact manufacturer of pollutant, if known and applicable, to obtain material safety data sheets (MSDS) and ascertain hazards involved and precautions and measures required in cleanup or mitigating actions.

.15 Take immediate action to contain and mitigate harmful effects of the spill or release.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Product quality, availability, storage, handling, protection, and transportation.

.2 Product substitution procedures.

.3 Manufacturer's instructions.

.4 Quality of Work, coordination and fastenings.

.5 Existing facilities.

1.2 RELATED SECTIONS

.1 Section 01 62 00 - Product Exchange Procedures.

.2 This section describes requirements applicable to all Sections.

1.3 DEFINITIONS

.1 New: Produced from new materials.

.2 Re-newed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.

.3 Defective: A condition determined exclusively by the Consultant.

1.4 PRODUCT QUALITY

.1 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work: New, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.

.2 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Consultant.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.5 AVAILABILITY

.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items.

.2 If delays in supply of Products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.3 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

1.6 STORAGE AND PROTECTION

.1 Store and protect Products in accordance with manufacturers' written instructions.

.2 Store with seals and labels intact and legible.

.3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.

.4 For exterior storage of fabricated Products, place on sloped supports above ground.

.5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.

.6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

.7 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

.8 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.7 TRANSPORTATION AND HANDLING

.1 Transport and handle Products in accordance with manufacturer's written instructions.

.2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.

.3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.8 PRODUCT CHANGES

.1 Change in Product/Products: Submit request for substitution or alternative in accordance with Section 01 62 00 – Product Exchange Procedures.

1.9 MANUFACTURER'S WRITTEN INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

1.10 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Consultant reserves right to require dismissal from site any workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

1.11 COORDINATION

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.12 CONCEALMENT

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Consultant if there is interference. Install as directed by Consultant.

1.13 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.14 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Consultant of conflicting installation. Install as directed.

1.15 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.16 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.17 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of any part of the Project.

.2 Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Consultant.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Substitutions.

.2 Alternatives.

.3 Separate prices.

1.2 RELATED SECTIONS

.1 Section 01 21 00 - Allowances.

.2 Section 01 29 00 - Payment Procedures.

.3 This section describes requirements applicable to all Sections.

1.3 SUBSTITUTIONS

.1 Consultant will consider requests for Substitutions only within fifteen (15) days after date of Owner-Contractor Agreement.

.2 Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.

.3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

.4 A request constitutes a representation that the Contractor:

.1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product and will provide a cost savings to the Owner.

.2 Will provide the same warranty for the Substitution as for the specified Product.

.3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

.4 Waives claims for additional costs or time extension which may subsequently become apparent.

.5 Will reimburse Owner and Consultant for review or redesign services associated with re-approval by authorities.

.5 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

.6 Substitution Submittal Procedure:

.1 Submit electronic copy of request for Substitution for consideration. Limit each request to one (1) proposed Substitution.

.2 Submit shop drawings, product data, and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.

.3 The Consultant will notify Contractor in writing of decision to accept or reject request.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Field engineering survey services to measure and stake site.

.2 Recording of subsurface conditions found.

.3 Survey services to determine measurement inverts for the Work.

.4 Requirements and limitations for cutting and patching the Work.

1.2 RELATED SECTIONS

.1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

.1 Owner's identification of existing survey control points and property limits.

1.4 SUBMITTALS

.1 Submit name and address of registered land surveyor performing survey work to Consultant.

.2 On request of Consultant, submit documentation to verify accuracy of field engineering work.

.3 Submit certificate signed by surveyor certifying those elevations and locations of completed Work that conform with Contract Documents.

.4 Submit the survey of the Work prepared and issued by a registered land surveyor on completion of the building footings and foundations and on completion of the Work.

1.5 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practise in the Place of the Work, acceptable to Consultant and Owner.

1.6 SURVEY REFERENCE POINTS

.1 Existing base horizontal and vertical control points are designated on Drawings.

.2 Locate and confirm permanent reference points prior to starting site Work. Preserve and protect permanent reference points on site during construction.

.3 Make no changes or relocations without prior written notice to Consultant.

.4 Report to Consultant when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.5 Require registered land surveyor to replace reference points in accordance with original survey.

1.7 SURVEY REQUIREMENTS

.1 Establish sufficient permanent benchmarks on site, referenced to established benchmarks by survey control points.

.2 Confirm that existing survey reference points are in accordance with Owner's survey and property limits.

.3 Record locations, with horizontal and vertical data in Project Record Documents.

.4 Establish lines and levels, locate and lay out, by instrumentation.

.5 Establish initial lines and levels for building layout.

.6 Stake for [grading] [landscaping features] [fill placement] [topsoil placement].

.7 Stake slopes [and berms].

.8 Establish pipe invert elevations.

.9 Stake batter boards [for foundations].

.10 Establish foundation [column locations] and floor elevations.

.11 Establish lines and levels for mechanical and electrical work.

.12 Maintain a complete, accurate log of control and survey work as it progresses. Record locations with horizontal and vertical data in project record documents.

.13 During any activity of the Work, employ a Land surveyor licensed to practice in the place of Work to layout and check all features, including but not limited to the following:

.1 Lay out building on the Site.

.2 Establish a permanent bench mark, or markers.

.3 Provide general dimensions, lines and elevations required by Subcontractors.

.4 Verify elevations of floor and roof levels as construction proceeds and relate to bench mark datum.

.5 Verify accuracy of site dimensions shown on Drawings.

.6 Provide a survey to verify location of footings immediately before construction of footings proceeds.

.7 Provide a survey to verify location of building related to property lines when foundation walls are completed to grade level.

.8 Provide a survey prior to placement of asphalt and concrete paving to confirm that grades conform to grades indicated on drawings.

.9 Provide a survey to verify location of completed building on Site.

1.8 VERIFICATION OF EXISTING CONDITIONS

.1 Where work specified in any Section is dependent on the work of another Section or Sections having been properly completed, verify that work is complete and in a condition suitable to receive the subsequent work. Commencement of work of a

Section that is dependent on the work of another Section or Sections having been properly completed, means acceptance of the existing conditions.

.2 Verify that ambient conditions are suitable before commencing the work of any Section and will remain suitable for as long as required for proper setting, curing, or drying of Products used.

.3 Ensure that substrate surfaces are clean, dimensionally stable, cured and free of contaminants.

.4 Notify Consultant in writing of unacceptable conditions.

1.9 SUBSURFACE CONDITIONS

.1 Promptly notify Consultant in writing if discovered surface or subsurface conditions at Place of Work differ materially from those indicated in Contract Documents.

.2 Advise the Consultant of a reasonable assumption of probable conditions when determined.

.3 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes or Change Orders set out in Section 01 29 00 – Payment Procedures.

1.10 EXAMINATION

.1 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of the Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

1.11 PREPARATION

.1 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.2 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

1.12 EXISTING UTILITIES AND STRUCTURES

.1 Before commencing work, including but not limited to, excavation, drilling or other earthwork, establish or confirm location and extent of all existing service lines, underground utilities and structures in area of Work.

.2 Promptly notify Consultant if underground utilities, structures, or their locations differ from those indicated in Contract Documents or in available project information. Consultant will provide appropriate direction.

.3 Record locations of maintained, re-routed and abandoned utility lines.

.4 Remove abandoned service lines within [<2 m><<6 ft>>] of structures. Cap or seal lines at cut-off points as directed by Consultant.

1.13 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Consultant of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

1.14 SURVEY RECORD

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

.3 Record locations of maintained, re-routed and abandoned service lines.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Requirements and limitations for cutting and patching of Work.

1.2 RELATED SECTIONS

.1 Section 01 10 00 - Summary of Work.

.2 Section 01 32 00 - Construction Progress Documentation.

.3 Section 01 61 00 - Product Requirements.

.4 Section 01 62 00 - Product Exchange Procedures.

.5 Section 07 84 00 - Firestopping.

.6 Individual Product Specification Sections:

.1 Cutting and patching incidental to work of the section.

.2 Advance notification to other sections of openings required in Work of those sections.

.3 Limitations on cutting structural members.

1.3 SUBMITTALS

.1 Submit written request in advance of cutting or alteration which affects:

.1 Structural integrity of any element of Project.

.2 Integrity of weather exposed or moisture resistant element.

.3 Efficiency, maintenance, or safety of any operational element.

.4 Visual qualities of sight exposed elements.

.5 Work of Owner or separate contractor.

.2 Include in request:

.1 Identification of Project.

.2 Location and description of affected Work.

.3 Necessity for cutting or alteration.

.4 Description of proposed Work and Products to be used.

.5 Alternatives to cutting and patching.

.6 Effect on work of Owner or separate contractor.

.7 Written permission of affected separate contractor.

.8 Date and time work will be executed.

Part 2 Products

2.1 MATERIALS

.1 Primary Products: Those required for original installation.

.2 Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 62 00 – Product Exchange Procedures.

Part 3 Execution

3.1 EXAMINATION

.1 Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

.2 After uncovering existing Work, assess conditions affecting performance of work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Perform cutting, fitting, patching and remedial work [including excavation and fill] to make the affected parts of the Work come together properly and complete the Work.

.5 Coordinate and perform the Work to ensure that cutting and patching work is kept to a minimum.

.6 Perform cutting, patching and remedial work using competent and qualified specialists familiar with the Products affected, in a manner that neither damages nor endangers the Work.

3.2 PREPARATION

.1 Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

.2 Provide protection from elements for areas which may be exposed by uncovering work.

.3 Maintain excavations free of water.

3.3 CUTTING

.1 Execute cutting and fitting including excavation and fill to complete the Work.

.2 Uncover work to install improperly sequenced work.

.3 Remove and replace defective or non-conforming work.

.4 Remove samples of installed work for testing when requested.

.5 Provide openings in the Work for penetration of mechanical and electrical work.

.6 Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

.7 Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.4 PATCHING

.1 Execute patching to complement adjacent Work.

.2 Fit Products together to integrate with other Work.

.3 Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

.4 Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.

.5 Restore work with new Products in accordance with requirements of Contract Documents.

.6 Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.7 At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to Section 07 84 00, to full thickness of the penetrated element.

.8 Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Progressive cleaning.

.2 Cleaning prior to acceptance.

1.2 RELATED SECTIONS

.1 This section describes requirements applicable to all Sections.

Part 2 Products

2.1 CLEANING MATERIALS

.1 Cleaning Agents and Materials: Low VOC content.

Part 3 Execution

3.1 PROGRESSIVE CLEANING

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site, unless approved by Consultant.

.3 Clear snow and ice from area of construction, bank or pile snow in designated areas only.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Containers:

.1 Provide on-site steel framed, hinged lid containers for collection of waste materials and debris.

.2 Provide and use clearly marked, separate bins for recycling.

.6 Remove waste material and debris from site and deposit in waste container at end of each working day.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of enclosure ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3.2 CLEANING PRIOR TO ACCEPTANCE

.1 Prior to applying for Substantial Performance of the Work, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.4 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site, unless approved by Consultant.

.5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.6 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.

.8 Clean lighting reflectors, lenses, and other lighting surfaces.

.9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.10 Clean and polish surface finishes, as recommended by manufacturer.

.11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.13 Clean equipment and fixtures to a sanitary condition; clean filters of mechanical equipment.

.14 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.15 Remove snow and ice from access to facilities.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Take-over procedures.

.2 Inspections and review.

.3 Prerequisites to final payment.

.4 Substantial performance of the work.

1.2 RELATED SECTIONS

.1 Section 01 78 10 – Closeout Submittals.

.2 All other Division 01 specification sections.

.3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 TAKE-OVER PROCEDURES

.1 The prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions of the Contract.

1.4 INSPECTIONS AND REVIEW

.1 Contractor's Inspection: Before applying for the Consultant’s review to establish Ready-for-Takeover of the Work:

.1 Ensure that the specified prerequisites to Ready-for-Takeover of the Work are completed.

.2 Conduct an inspection of the Work to identify defective, deficient, or incomplete work.

.3 Prepare a comprehensive and detailed list of items to be completed or corrected.

.4 Provide an anticipated schedule and costs for items to be completed or corrected.

.2 Consultant’s Review: Upon receipt of the Contractor’s application for review, together with the Contractor’s list of items to be completed or corrected, the Consultant will review the Work. The Consultant will advise the Contractor whether or not the Work is Ready-for-Takeover and will provide the Contractor with a list of items, if any, to be added to the Contractor’s list of items to be completed or corrected. Provide the Consultant with a copy of the Contractor’s revised list.

.3 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor’s inspection and Consultant’s review procedures specified above shall be repeated until the Work is Ready-for-Takeover and no items remain on the Contractor’s list of items to be completed or corrected.

.4 When the Consultant determines that the Work is Ready-for-Takeover, the Consultant will notify the Contractor and the Owner in writing to that effect.

1.5 PREREQUISITES TO FINAL PAYMENT

.1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:

.1 Correct or complete all remaining defective, deficient, and incomplete work.

.2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.

.3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 00 – Cleaning and Waste Management.

1.6 SUBSTANTIAL PERFORMANCE OF THE WORK

.1 The prerequisites to, and the procedures for, attaining substantial performance of the Work, or similar such milestone as provided for in the lien legislation applicable to the Place of the Work, shall be:

.1 independent of those for attaining Ready-for-Takeover of the Work, and

.2 in accordance with the lien legislation applicable to the Place of the Work.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Inspections and declarations.

.2 Closeout submittals.

.3 Operation and maintenance manual format.

.4 Contents each volume.

.5 Recording actual site conditions.

.6 Record (as-built) documents and samples.

.7 Record documents.

.8 Final survey.

.9 Warranties and bonds.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 - Quality Control.

.3 This section describes requirements applicable to all Sections.

1.3 REVIEW / TAKE-OVER PROCEDURES

.1 In accordance with OAA/OGCA Document 100, latest edition, except where specified otherwise.

.2 In OAA/OGCA Document 100, where the term “Architect” is used, substitute the term “Consultant”, and where the term “inspection” is used in relation to the Consultant’s assessment of the Work, substitute the term “review”.

.3 Arrange and pay for review by local authorities to obtain permission to occupy/occupancy permit (where applicable) prior to requesting Substantial Performance.

.4 Refer also to Section 01 29 00 Payment Procedures for requirements related to applications for certificates and for applications for payment.

1.4 PREREQUISITES TO FINAL PAYMENT

.1 Remove from the place of Work all remaining surplus Products, Construction Equipment, and Temporary Work.

.2 Perform final cleaning and waste removal necessitated by the Contractor’s work performed after Ready-For-Takeover, as specified in Section 01 74 00 – Cleaning and Waste Management

1.5 INSPECTIONS AND DECLARATIONS

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.2 Request Consultant's Inspection.

.2 Consultant's Inspection: Consultant and Contractor will perform review of Work to identify defects or deficiencies. Correct defective and deficient Work accordingly.

.3 Completion: Submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, balanced and are fully operational.

.4 Certificates required by authorities having jurisdiction have been submitted.

.5 Operation of systems have been demonstrated to Owner's personnel.

.6 Work is complete and ready for Final Inspection.

.4 Final Inspection: When items noted above are completed, request final inspection of Work by Consultant Contractor. If Work is deemed incomplete by Consultant, complete outstanding items and request reinspection.

.5 Declaration of Substantial Performance: When Consultant considers deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for Substantial Performance of the Work.

.6 Commencement of Warranty Periods: The date of Substantial Performance of the Work shall be the date for commencement of the warranty period.

.7 Commencement of Lien Periods: The date of publication of the certificate of Substantial Performance of the Work shall be the date for commencement of the lien period, unless required otherwise by the lien legislation applicable at the Place of the Work.

.8 Payment of Standard Hold-back: After issuance of certificate of Substantial Performance of the Work, submit an application for payment of standard hold-back amount.

.9 Final Payment: When Consultant considers final deficiencies and defects have been corrected and it appears requirements of Contract have been completed, make application for final payment.

.10 Payment of Final Holdback: After issuance of Certificate of Deemed Completion of the Work, submit an application for payment of finishing holdback amount.

1.6 CLOSEOUT SUBMITTALS

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Copy will be returned with Consultant's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, two (2) final copies of operating and maintenance manuals in Canadian English.

.5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.6 If requested, furnish evidence as to type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

1.7 OPERATION AND MAINTENANCE MANUAL FORMAT

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Photos: 8x10 high quality colour prints on photo paper.

.10 Provide scaled CAD files in AutoCAD and *PDFs on CD / DVD.

1.8 OPERATION AND MAINTENANCE MANUAL CONTENTS - EACH VOLUME

.1 Table of Contents: Including but not limited to:

.2 Project Information:

.1 Title of project.

.2 Date of submission.

.3 Names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.

.4 Schedule of products and systems, indexed to content of volume.

.5 Record Documents (see details below).

.6 Warranties and Bonds (see details below).

.3 Copy of Building Permit.

.4 Copies of field tests, all inspection and testing reports

.5 Relevant certificates issued by authorities having jurisdiction including fire alarm verification certificate; final inspection certificate by Electrical Safety Authority; sprinkler test verification certificate; and certificates issued by other authorities.

.6 For Mechanical and Electrical include: description of system; controls including diagrams; maintenance and testing schedule; method of operation for each piece of equipment, and list of equipment with replacement parts, parts number, suppliers, addresses, etc. Refer also to Divisions 21 through 28 as applicable for particular requirements relevant to respective Division.

.7 Neatly typed lists and notes. Use clear drawings, diagrams or manufacturers' literature

.8 Complete set of reviewed shop drawings and product data sheets, indicating corrections and changes made during fabrication and installation.

.9 Maintenance instructions for finished surfaces and materials.

.10 Copy of hardware schedule.

.11 Copy of paint schedule.

.12 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts

.13 Product Data: Organize data by specification number. Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.

.14 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.15 Photographs: Monthly photographs as per section 01 32 00 Construction Progress Documentation.

1.9 RECORDING ACTUAL SITE CONDITIONS

.1 Applies to: As-Found Inventories, Repair Inventories, and As-Built Drawings.

.2 Record information on set of black line opaque drawings, and within the Project Manual.

.3 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.

.4 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.

.5 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.6 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.7 Other Documents: Maintain manufacturer's certifications, field test records and inspection certifications required by individual specifications sections.

1.10 AS-BUILT DOCUMENTS AND SAMPLES

.1 Maintain for Consultant and Owner, two (2) record copies of:

.1 Contract Drawings and as-built drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to the Contract.

.5 Reviewed shop drawings, product data, and samples.

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.9 As-found and monthly construction photographs (2 per page).

.2 Store as-built documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label as-built documents and file in accordance with section number listings in List of Contents of the Project Manual. Label each document AS-BUILT DOCUMENTS in neat, large, printed letters.

.4 Maintain as-built documents in clean, dry and legible condition. Do not use as-built documents for construction purposes.

.5 Keep as-built documents and samples available for inspection by Consultant.

1.11 AS-BUILT DRAWINGS

.1 Prior to Substantial Performance of the Work, provide the marked up as-built documentation to a master set of drawing and specification files provided by the Consultant, as follows:

.1 Drawings: PDF and one (1) set full sized print.

.2 Specifications: PDF.

.2 Mark revised documents as AS-BUILT DRAWINGS/SPECIFICATIONS. Include all revisions, company name and date.

1.12 WARRANTIES AND BONDS

.1 Warranties and bonds to be included in the Operation and Maintenance Manual.

.2 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.3 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.4 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work.

.5 Provide manufacturer’s product guarantees and warranties, executed in the name of the Owner, showing name and address of project and guaranty/warranty commencement date and duration of the guaranty/warranty, and clear indication of what is being guaranteed and what remedial action will be taken under guaranty/warranty.

.6 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.7 Verify that documents are in proper form, contain full information, and are notarized.

.8 Co-execute submittals when required.

.9 Retain warranties and bonds until time specified for submittals.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 At no cost to the Owner, all labour and materials to correct the defects and deficiencies. This shall include removal and reinstating components where required to gain access to defect and/or deficiency.

.2 All performance and aesthetic related issues as determined by the Consultant, such as leakage, debonding, corrosion, fading, discolouration, etc.

.3 Excludes reasonable wear and tear.

1.2 WARRANTY PERIOD

.1 The warranty period is from the date of Ready-for-Takeover as per CCDC2-2020.

.2 The warranty period is two years unless otherwise noted.

Part 2 **Products** (Not Used)

Part 3 **Execution** (Not Used)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Procedures for demonstration and instruction of Products, equipment and systems to Owner's personnel.

.2 Seminars and demonstrations.

1.2 RELATED SECTIONS

.1 This section describes requirements applicable to all Sections.

1.3 DESCRIPTION

.1 Demonstrate operation and maintenance of systems and equipment to Owner's personnel prior to date of final inspection.

.2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 SUBMITTALS

.1 Submit schedule of time and date for demonstration of each item of equipment and each system prior to designated dates, for Consultant's approval.

.2 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.3 Give time and date of each demonstration, with list of persons present.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 PREPARATION

.1 Verify that suitable conditions for demonstration and instructions are available.

.2 Verify that designated personnel are present.

.3 Prepare agendas and outlines.

.4 Establish seminar organization.

.5 Explain component design and operational philosophy and strategy.

.6 Develop equipment presentations.

.7 Present system demonstrations.

.8 Accept and respond to seminar and demonstration questions with appropriate answers.

3.2 PREPARATION OF AGENDAS AND OUTLINES

.1 Prepare agendas and outlines including the following:

.1 Equipment and systems to be included in seminar presentations.

.2 Name of companies and representatives presenting at seminars.

.3 Outline of each seminar's content.

.4 Time and date allocated to each system and item of equipment.

.5 Provide separate agenda for each system.

3.3 SEMINAR ORGANIZATION

.1 Coordinate content and presentations for seminars.

.2 Coordinate individual presentations and ensure representatives scheduled to present at seminars are in attendance.

.3 Arrange for presentation leaders familiar with the design, operation, maintenance and troubleshooting of the equipment and systems. Where a single person is not familiar with all aspects of the equipment or system, arrange for specialists familiar with each aspect.

.4 Coordinate proposed dates for seminars with Owner and select mutually agreeable dates.

3.4 EXPLANATION OF DESIGN STRATEGY

.1 Explain design philosophy of each system. Include following information:

.1 An overview of how system is intended to operate.

.2 Description of design parameters, constraints and operational requirements.

.3 Description of system operation strategies.

.4 Information to help in identifying and troubleshooting system problems.

3.5 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times at the designated location.

.2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Instruct personnel on control and maintenance of sensory equipment and operational equipment associated with maintaining energy efficiency and longevity of service.

.4 Review contents of manual in detail to explain all aspects of operation and maintenance.

.5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 05 73 Wood Treatment

.2 Section 31 04 31 - HISTORIC - SUBGRADE SHORING AND BRACING

.3 Section 31 23 33.01- Excavating, Trenching and Backfilling

1.2 DEFINITIONS

.1 Bracing: Temporary support installed in an excavation or a structure to stabilize against deformations or failure. (Resisting lateral loads).

.2 Shoring: Temporary support installed in an excavation or a structure to relieve loads.

.3 Dead Shoring or Vertical Shoring: A vertical member with a head plate, sole plate and a means of tightening and easing the shore. Used to support dead loads which act vertically downwards.

.4 Poling Board:A timber plank driven into soft soil, or held in place by waling planks and struts, to support the sides of an excavation.

.5 Soldier Pile: A vertical member, held in place by struts, bolts, or wires and supported by struts across an excavation to prevent the movement of formwork that takes the side thrust from horizontal sheeting.

.6 Heritage Materials: Elements of historic significance or character- defining features of a historic place, which document the history of the related building assembly, built feature or constructed element, as defined in the Project Documents.

1.3 REFERENCE STANDARDS

.1 CSA Group (CSA):

.1 CSA B111-74, Wire Nails, Spikes and Staples

.2 CSA G40.20-13/G40.21-, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.3 CSA O86 Consolidation- 14, Engineering Design in Wood.

.4 CSA O151-09, Canadian Softwood Plywood

.5 CSA S16-14, Design of Steel Structures

.6 CSA W59-18, Welded Steel Construction

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures .

.2 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

.2 Provide shoring, bracing and temporary framing detail drawings signed by professional engineer registered or licensed in Ontario, Canada.

.3 Provide details on how to avoid introducing stress and damage at the point of contact of shores or bracing with heritage materials.

Part 2 Products

2.1 MATERIALS

.1 Structural Wood Members: SPF grade No. 1.

.1 Forest Stewardship Council (FSC) certified.

.1 Lumber:

.1 FSC certified.

.2 NLGA certified.

.2 Structural Steel Members (beams and columns): ASTM A992/992M, grade 50 (Fy = 345 MPa). All H.S.S. to conform to CAN/CSA G40.21, grade 350W (Class C).

.3 Aluminum or steel adjustable telescopic shoring props to DIN EN16031 with braces and connections to have sufficient capacity to resist loads shown on Drawings and in accordance to instructions of the Consultant.

.4 Wood Connections: Canadian soft wood plywood to sheathing grade.

.1 Forest Stewardship Council (FSC) certified.

.1 Lumber:

.1 FSC certified

.2 NLGA certified

.5 Wood sheathing: Canadian soft wood plywood, 12mm (1/2") thickness min.

.1 Forest Stewardship Council (FSC) certified.

.1 Lumber:

.1 FSC certified

.2 NLGA certified

.6 Steel Connections: Steel angles and channels to CSA G4020/G40.21, grade 350W.

.7 Nails: to conform to steel wire nails and spikes as defined CSA B111 "Wire nails, Spikes and Staples"

.8 Bolts: Lag screws, nuts and washers to CSA O86.1 and be grade A307

.9 Welding Materials: to conform CSA W59and CSA W47.1 and completed by CWB certified welders

2.2 PERFORMANCE CRITERIA

.1 Ensure materials, equipment and procedures:

.1 safely support existing structure and construction live loads,

.2 allow work to be accomplished, and

.3 minimize risk of damage to historic and archaeological elements.

2.3 SOURCE QUALITY CONTROL

.1 Timber Identification: Grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood Identification: Grade mark in accordance with applicable CSA standards

Part 3 Execution

3.1 EXAMINATION

.1 Before starting work, verify existing conditions and variations from original Contract Documents and notify Consultant.

3.2 PREPARATION

.1 Before disturbing any building components, verify that a Designated Substance Report (DSR) has been prepared in accordance with Section 01 14 25 - Designated Substances Report.

.2 Remove stored materials from building. Store in area designated by Owner / Consultant.

.3 Before beginning shoring, brace window and door openings.

.1 Remove, protect and store window sashes.

.2 Remove, protect and store doors.

.3 Protect glazingcomponents.

.4 Brace chimneyscomponents.

.4 Before beginning bracing and/or shoring:

.1 Drain ground to support bracing and any soils relevant to bracing work. Verify soil conditions under bracing or shoring to ensure settlement will not occur. Keep area dry and free of standing water for duration of Work.

.2 Protect historic fabric or elements in direct contact with bracing or shoring components. Request review by Consultant.

.3 Provide protection between shoring and/or bracing to prevent rust stains on historic fabric.

.4 Perform structural repairs to facilitate temporary works.

.5 Treat wood in contact with ground in accordance with Section 06 05 73 Wood Treatment.

3.3 INSTALLATION - GENERAL

.1 Start work in accordance with instructions from Consultant.

.2 Obtain approval from Consultant, before execution, for alteration to bracing and/or shoring system.

.3 Support individual elements that become loose during shoring and/or bracing installation.

.4 Erect structural timber to CSA O86.1.

.5 Erect structural steel work to CSA S16 and CSA S136.

.6 Weld to CSA W59and CSA W47.1 and completed by CWB certified welders

3.4 BRACING OF STRUCTURES

.1 Compensate for unevenness of wall surfaces:

.1 Install shims behind wall pieces as required to facilitate even bearing and support.

.2 Install protection.

.3 Install and use bracing system tostabilize deformations, as indicated on drawings.

3.5 BRACING OF EXCAVATIONS

.1 Conduct work in accordance with the current OHSA legislation and in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling

.2 Allow drainage in water bearing ground.

3.6 ADJUSTMENT

.1 Monitor shoring and/or bracing system performance and maintain its effectiveness by making adjustments, replacing or repairing damaged and weakened elements of system until final completion of project for period of after installation of the shoring.

.2 If adjustments are made, notify Consultant.

3.7 SHORING REMOVAL

.1 Remove temporary shoring and bracing only when the Consultanthas given written approval.

.2 Examine contact interface of shoring and/or bracing with historic fabric in the presence of Consultant. Where the historic fabric has been damaged, restore damaged area to replicate the adjacent comparable finishes to the satisfaction of the Consultant and at no additional cost to Owner.

.3 Remove temporary bracing and/or shoring from site.

END OF SECTION

CITY OF TORONTO

SPADINA HOUSE MUSEUM – STONE GARAGE

TECHNICAL SPECIFICATIONS

FOR

DESIGNATED SUBSTANCE AND HAZARDOUS MATERIALS ABATEMENT

TABLE OF CONTENTS

Section		# of pages
00 01 00	Cover Page	1
00 10 00	Table of Contents	1
	DIVISON 1 – RESERVED	
	DIVISON 2 – EXISTING CONDITIONS	
02 82 00	Abatement Scope and Details	8
02 82 01	Type 1 Asbestos Abatement	10
02 82 02	Type 2 Asbestos Abatement	14
02 82 04	Type 3 Asbestos Abatement	21
02 83 00	Lead Abatement	23
02 83 10	Other Hazardous Materials	18
02 84 00	PCB Capacitors and Ballasts	10
	DIVISON 3 to 48 – RESERVED	

1. DRAWINGS

1.1. The Drawings forming part of Contract Documents are listed below and bound with the specifications.

Dwg. NO.	TITLE	DATE
A-##	<<reserved>>	Month, Year

2. REPORTS AND REFERENCES

2.1. Reports and/or references forming part of Contract Documents are listed below and bound with the specifications.

2.1.1. *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

LIST OF CONTENTS

Page

1. GENERAL 2

1.1 General And Related Work 2
1.2 Site Conditions 2
1.3 Outline of Work 2
1.4 Schedule 4
1.5 Supervision 5
1.6 Quality Assurance 5
1.7 Regulations 6
1.8 Notification 7
1.9 Submittals 7
1.10 Waste Transport And Disposal 8

2. PRODUCTS 8

2.1 Refer to Part 2 of related Sections of work. 8

3. EXECUTION 8

3.1 Refer to Part 3 of related Sections of work. 8

1. GENERAL

1.1 General And Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere

Division 02	Section 02 82 01	Type 1 Asbestos Abatement
Division 02	Section 02 82 02	Type 2 Asbestos Abatement
Division 02	Section 02 82 04	Type 3 Asbestos Abatement
Division 02	Section 02 83 00	Lead Abatement
Division 02	Section 02 83 10	Other Hazardous Materials
Division 02	Section 02 84 00	PCB Capacitors and Ballasts

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 This specification fulfils the requirements of the report required by Designated Substance – *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, Ontario Regulation 278/05, Section 10.

1.1.4 The Construction Contractor is responsible to verify all measurements for removal, cleaning, re-insulation and re-instatement purposes. Measurements and quantities provided herein are for reference only.

1.1.5 It is the intent that work performed as per this section will result in the removal and/or decontamination and disposal of all designated substances and hazardous materials, as well as all materials that have been contaminated by designated substances or hazardous materials either during or prior to work of this section.

1.2 Site Conditions

1.2.1 Refer to report, *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023, for site conditions and description of designated substance and hazardous materials present in the existing Facility.

NOTE: Attachment 1 is for reference purposes only. The Construction Contractor is to verify site conditions and all requirements necessary to complete abatement. Report all discrepancies to the Project Manager.

1.3 Outline of Work

1.3.1 Co-operate fully with the on-site Abatement Consultant in confirming work areas and methods to be used in performing work. Assist the on-site Abatement

Consultant in confirming the extent and specific location of designated substance and hazardous materials.

1.3.2 The Construction Contractor must have a representative on-site at all times when work is being completed. The Construction Contractor shall provide one Abatement Supervisor to coordinate all work (in all areas) with the Abatement Consultant.

1.3.3 Water is available from existing Facility sources. Construction Contractor is responsible for water connection (including installation of fittings if required) from existing Facility water supply lines. Construction Contractor shall install fittings (if required) using vacuum breakers or other backflow preventer as required by Governmental Authorities.

1.3.4 Power to be supplied from existing Facility service.

1.3.5 Coordinate with the Facility's Building Automated System (BAS) system operator prior to and after abatement work.

1.3.6 Disable fire alarms, heat detectors and smoke detectors in Abatement Work Areas. At no time are the above Life Safety Devices to be affected in areas outside the Abatement Work Areas. Reconnect Life Safety Devices at completion of abatement and reinstatement work. Coordinate with and notify Contracting Authority as necessary.

1.3.7 The removal methodology of designated substances and hazardous materials shall comply with recommendations in Attachment 1, *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023, and requirements of Governmental Authorities.

1.3.8 Abatement work area isolation shall be completed as per specifications in related sections (i.e., Item 1.1.2.).

1.3.9 Complete demolition, removal and new work as identified in drawings prepared by Others.

1.3.10 Summary of Asbestos-Containing Materials (ACM)

1.3.10.1 Asbestos safety precautions are required for the removal of the following materials, as per the definition of work classification and work requirements, as outlined in Sections 02 82 01, 02 82 02, and 02 82 04.

1.3.10.1.1 Vinyl Sheet Flooring (VSF07) Beige with diamond pattern (**25% Chryostile**).

1.3.10.1.2 Vinyl Floor Tiles (VFT2) 12" x 12" Brown with white streaks (**3% Chrysotile**).

1.3.10.1.3 Soft black window caulking (**4% Chrysotile**).

1.3.10.1.4 Plaster on ceilings (**1% Chrysotile**).

1.3.10.1.5 Parging Cement (**50-75% Chrysotile**).

1.3.10.1.6 Hard black caulking (**1% Chrysotile**).

1.3.10.1.7 Interior boiler materials (**Assumed**).

1.3.10.2 Refer to report, *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto,*

ON, prepared by ECOH Management Inc., June 20, 2023, for specific locations and descriptions of asbestos-containing material.

1.3.11 Summary of Lead-Based and Lead-Containing Materials

1.3.11.1 Lead safety precautions are required for the removal of the following materials, as per the definition of work classification and work requirements, as outlined in Sections 02 83 00.

1.3.11.1.1 Off-White Paint (**96,000 ppm**).

1.3.11.1.2 Brown Paint (**14,000 ppm**).

1.3.11.1.3 Green Pain (**3,200 ppm**).

1.3.11.2 Refer to report, *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023, for specific locations and descriptions of lead-based and lead-containing materials.

1.3.12 Best practices dust suppression and general health and safety precautions are required for the removal of the following materials, as per the definition of work classification and work requirements, as outlined in Section 02 83 10-Other Hazardous Materials.

1.3.12.1 Mercury,

1.3.12.2 Silica,

1.3.12.3 And other designated substance and hazardous materials including; Acrylonitrile, Arsenic, Benzene, Coke Oven Emissions, Ethylene Oxide, Foam glass, Isocyanates, Mould, Ozone Depleting Substances (ODS), Urea Formaldehyde Foam Insulation (UFFI), and Vinyl Chloride Monomer, which were not noted in significant quantities or forms, or in isolation from other materials, if at all.

1.3.13 Items containing PCBs shall be removed as per Section 02 84 00-PCB Capacitors and Ballasts.

1.3.13.1 PCB-containing ballasts may be present.

1.3.13.2 Previous assessments have reported that no liquid filled transformers are present (i.e., transformers are dry type units).

1.3.14 Removal of mould contaminated materials, that are present in isolation from other significant designated substances and hazardous materials, shall be completed following the Environmental Abatement Council of Canada (EACC) document, *Mould Abatement Guidelines*, Edition 3 (2015).

1.3.14.1 Refer to report, *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023, for specific locations and building materials that are water damaged and/or mould contaminated.

1.4 Schedule

1.4.1 Abatement work schedule, zoning and phasing to be determined by the Construction Contractor.

1.5 Supervision

1.5.1 The Construction Contractor shall provide one on-site Superintendent that has the authority to oversee all aspects of the work, including but not limited to, negotiation of Variation to the contract, scheduling, manpower, equipment, production, communication and co-ordination with the Abatement Consultant.

1.5.2 The Abatement Consultant reserves the right to reject or accept any Superintendent without explanation.

1.5.3 The Construction Contractor shall ensure that:

1.5.3.1 Every worker and supervisor successfully completed the appropriate program required before performing or supervising the work to which the program relates,

1.5.3.2 A copy of the document issued by the Ministry of Training, Colleges and Universities, showing that a worker has successfully completed the above-mentioned program or has successfully completed equivalent training in another province or territory of Canada, is provided to the Abatement Consultant.

1.5.4 In addition to the above training requirements, the Construction Contractor shall ensure that all workers and supervisors receive asbestos awareness refresher training course at reasonable time intervals, when appropriate. The asbestos awareness refresher training course shall meet the requirements of Ontario Regulation 278/05. Copies of the Certificates issued at successful completion of the asbestos awareness refresher training course shall be provided to the Abatement Consultant.

1.5.5 All supervisors and workers shall have training corresponding to work related to the handling of other designated substances and hazardous materials.

1.5.6 Supervisory personnel must be on site at all times during work that may disturb designated substances and hazardous materials.

1.5.7 The Construction Contractor cannot replace supervisory personnel without written approval from the Abatement Consultant.

1.6 Quality Assurance

1.6.1 Ensure the removal and handling of designated substances and hazardous materials, or materials contaminated by designated substances and hazardous materials, are performed by trained and competent personnel. The Abatement Consultant reserves the right to remove any personnel that, in their opinion, does not meet these qualifications.

1.6.2 All related work of this section shall be performed by licensed persons, experienced and qualified for the work required.

1.6.3 The Abatement Consultant is empowered to order work to stop when prescribed health and safety measures and/or health and safety procedures and/or health and safety facilities are not, or are likely not to be, fully implemented. Cost of additional work by the Construction Contractor and/or the Abatement Consultant to fully re-establish health and safety measures and/or health and safety procedures and/or health and safety facilities shall be the burden of the Construction Contractor.

1.6.4 The Construction Contractor is solely responsible for the control of the project, construction practices, their Sub Construction Contractors or their agents, employees or other persons performing any of the Work.

1.7 Regulations

1.7.1 Comply with Federal, Provincial, and local requirements pertaining to designated substance and hazardous material removal and general demolition activities, provided that in any case of conflict among those requirements, or with these specifications, the more stringent requirement shall apply. The regulations and guidelines shall include, but not be limited to, the latest edition, version or update of the following references:

1.7.1.1 Ontario Environmental Protection Act, R.S.O. 1990, c.E.19.

1.7.1.2 Ontario Dangerous Goods Transportation Act, R.S.O. 1990 c. D1.

1.7.1.3 Ontario Occupational Health and Safety Act, R.S.O. 1990 c. O.1.

1.7.1.4 Ontario Regulation 164/99, Electrical Safety Code.

1.7.1.5 Ontario Regulation 213/07, Fire Code.

1.7.1.6 Ontario Regulation 213/91, Construction Projects.

1.7.1.7 Ontario Regulation Ontario Regulation 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.

1.7.1.8 Ontario Regulation 347, General – Waste Management.

1.7.1.9 Ontario Regulation 362, Waste Management – PCBs.

1.7.1.10 Ontario Regulation 463/10, Ozone Depleting Substances and Other Halocarbons.

1.7.1.11 Ontario Regulation 490/09, Designated Substances.

1.7.1.12 Ontario Regulation 833, Control of Exposure to Biological or Chemical Agents.

1.7.1.13 Ontario Regulation 860, Workplace Hazardous Materials Information Systems (WHMIS).

1.7.1.14 Ontario Regulation 164/99, Electrical Safety Code.

1.7.1.15 Ministry of Labour Guideline, Occupation Health and Safety Branch, "*Silica on Construction Projects*", April 2011.

1.7.1.16 Ministry of Labour document "*Guideline - Lead on Construction Projects"*, dated April 2011.

1.7.1.17 Environmental Abatement Council of Canada (EACC) document; "*Lead Guideline for Construction, Renovation, Maintenance or Repair*", dated October 2014.

1.7.1.18 Canadian Construction Association, Standard Construction Document CCA 82, 2004; "*mould guidelines for the Canadian construction industry*".

1.7.1.19 Environmental Abatement Council of Canada (EACC) document; "*Mould Abatement Guidelines*", Edition 3, 2015.

1.7.1.20 Environmental Abatement Council of Canada (EACC) document; "*Construction Worker Hygiene Practices Guideline*", dated 2014.

1.7.1.21 Environmental Abatement Council of Canada (EACC) document; "Performance Leak testing Guideline for HEPA Filtered Equipment", dated 2021.

1.7.1.22 Canadian Transportation of Dangerous Goods Act, (S.C. 1992, c. 34).

1.7.1.23 Canadian Transportation of Dangerous Goods Regulations, SOR/2001-286.

1.7.1.24 Canadian Surface Coating Materials Regulations, SOR/2005-109.

1.7.1.25 Canadian PCB Regulations, SOR/2008-273.

1.7.1.26 Canadian Federal Halocarbon Regulations, 2003, SOR/2003-289.

1.8 Notification

1.8.1 Notify Sanitary Landfill site as per Ontario Regulation 347, as amended, under the Environmental Protection Act.

1.8.2 Inform all sub trades of the presence of designated substances and hazardous materials identified in the site conditions.

1.8.3 Notify immediately Ontario Ministry of Labour, as required by Ontario Regulation 278/05, Section 10(7), if asbestos-containing materials not identified in the site conditions are discovered during the project.

1.9 Submittals

1.9.1 Submit prior to commencing work:

1.9.1.1 Construction Contractor to prepare a site specific Health and Safety Plan (HASP), to address safety issues, including but not limited to the following;

1.9.1.1.1 Access and emergency evacuation from work areas.

1.9.1.1.2 Creating and maintaining clear routes for work area access and emergency evacuation.

1.9.1.1.3 Work site communication.

1.9.1.2 Permits for transportation of designated substance and hazardous material waste and location of landfill.

1.9.1.3 Proof that workers have received WHMIS training.

1.9.1.4 Proof that workers have received Occupational Health and Safety Awareness and Training.

1.9.1.5 Work Place Safety and Insurance Clearance Certificates.

1.9.1.6 Pre-removal survey of damage in all areas where designated substance and hazardous material abatement will take place or waste will be transported.

1.9.1.7 Proposed schedule including all stages of work.

1.9.1.8 Shop drawings for each Work Area detailing, as is applicable to project requirements, waste and worker decontamination facilities, platform and hoarding layouts, Safety Data Sheets (SDS) for chemicals or materials used in the course of the project, etc.

1.9.1.9 Certificate proving that each worker on-site has been fit tested for the respirator appropriate for the work being performed.

1.9.2 Submit names of supervisory personnel who will be responsible for designated substance and hazardous material removal work area(s). One of these supervisors must remain on site at all times designated substance and hazardous material removal or clean-up is occurring. Submit proof that supervisory personnel have attended training course on asbestos control (2-day minimum duration) and have performed supervisory function on at least 5 other asbestos abatement projects of a similar size and complexity.

1.10 Waste Transport And Disposal

1.10.1 Ensure designated substance and hazardous material-containing or designated substance and hazardous material-contaminated materials, removed during abatement are treated, packaged, transported and disposed of according to the appropriate waste stream.

1.10.2 Drop garbage bins at designated locations. Keep bins covered, enclosed and secured while at the site. Bin loading area shall be kept clean at all times.

1.10.3 Pick-up and drop off of garbage bin shall be at pre-approved times, and must not interfere with the Facilities operations.

1.10.4 Conform to requirements of Regulations under Environmental Protection Act for Waste Management, transporting and disposal of hazardous waste.

1.10.5 Ensure shipment of containers to dump is taken by waste hauler licensed to transport the specific waste stream.

1.10.6 Each load requires completion of bill of lading showing type and weight of hazardous waste being transported.

1.10.7 Check with dump operator to determine type of waste containers acceptable.

1.10.8 Ensure dump operator is fully aware of hazardous material being dumped.

1.10.9 Co-operate with Ministry of Environment and Climate Change inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to Contracting Authority.

2. PRODUCTS

2.1 Refer to Part 2 of related Sections of work.

3. EXECUTION

3.1 Refer to Part 3 of related Sections of work.

End of Section.

LIST OF CONTENTS

Page

1. GENERAL 2

1.1 General And Related Work 2
1.2 Definitions 3
1.3 Worker Protection 5
1.4 Visitor Protection 6
1.5 Air Monitoring 6

2. PRODUCTS 7

2.1 Materials and Equipment 7

3. EXECUTION 8

3.1 Site Preparation 8
3.2 Removal 9
3.3 Work Area Clean Up and Exit from the Work Area 9

1. GENERAL

1.1 General And Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere

Division 2	Section 02 82 00	Abatement Scope and Details
Division 2	Section 02 82 02	Type 2 Asbestos Abatement
Division 2	Section 02 82 04	Type 3 Asbestos Abatement
Division 2	Section 02 83 00	Lead Abatement
Division 2	Section 02 83 10	Other Hazardous Materials
Division 2	Section 02 84 00	PCB Capacitors and Ballasts

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 This specification fulfils the requirements of the report required by Designated Substance – *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, Ontario Regulation 278/05, Section 10.

1.1.4 The Contractor is responsible to verify all measurements for removal, cleaning, and re-insulation purposes. Measurements and quantities provided herein are for reference only.

1.1.5 It is the intent that work performed as per this section will result in the removal and disposal or decontamination of all asbestos-containing material (ACM), as well as all materials that have been contaminated by ACM either during or prior to work of this section.

1.1.6 Refer to Section 02 82 00, Abatement Scope and Details, for the following information and requirements;

1.1.6.1 Site Conditions,

1.1.6.2 Outline of Work,

1.1.6.3 Schedule,

1.1.6.4 Supervision,

1.1.6.5 Quality Assurance,

1.1.6.6 Regulations,

1.1.6.7 Notification,

1.1.6.8 Submittals, and

1.1.6.9 Waste Transport And Disposal.

1.2 Definitions

1.2.1 Air Monitoring: The process of measuring the fibre content of a specific volume of air.

1.2.2 Amended Water: Water with a non-ionic surfactant wetting agent added to reduce water surface tension to 35 or less dynes, to allow thorough wetting of asbestos fibres.

1.2.3 Asbestos: The serpentine and amphibole asbestiform varieties including chrysotile, actinolite, amosite, anthophyllite, crocidolite and tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.

1.2.4 Asbestos Abatement Consultant: The Owner or person designated by the owner to provide inspection and air monitoring of the Contractor's work.

1.2.5 Asbestos-Containing Material (ACM): Any material that contains 0.5 per cent or more asbestos, of any type or mixture of types, by dry weight.

1.2.6 Asbestos-Containing Waste Material: Any material which is or is suspected of being or any material contaminated with an asbestos-containing material which is to be removed from a work area for disposal.

1.2.7 Asbestos Debris: Pieces of ACM that can be identified by colour, texture, or composition, or means dust, if the dust is determined by an accredited Asbestos Abatement Consultant to be ACM.

1.2.8 Asbestos Work Area: Where the actual removal, sealing and enclosure of asbestos-containing materials takes place.

1.2.9 Authorized Visitor: The Owner or his approved representative and/or persons representing regulatory agencies.

1.2.10 Barrier: Any surface that seals off the work area to inhibit the movement of fibres.

1.2.11 Clean Area: Either an operating area or an area in which removal work has already been completed.

1.2.12 Demolition: The wrecking or taking out of any Facility component, system, finish or assembly of a facility together with any related handling operations.

1.2.13 Disposal Bag: A properly labelled 6 mil thick leak-tight plastic bag used for transporting asbestos waste from the work area to the disposal site.

1.2.14 DOP / PAO Test: Dioctylphthalate / Poly Alpha Olefin aerosol challenge of a HEPA filter system and is used to establish the integrity and effectiveness of the system to filter out asbestos fibres.

1.2.15 Encapsulant: A material that surrounds or embeds asbestos fibres in an adhesive matrix, to prevent release of fibres.

1.2.16 Encapsulation: Applying an encapsulant to asbestos-containing materials.

1.2.17 Filter: A media component used in respirators, vacuum cleaners or negative pressure filter fan units to remove solid or liquid particles from the inspired air.

1.2.18 Friable Asbestos Material: Material that contains asbestos that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.19 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.

1.2.20 Occupied Area: Any area of the Facility outside the Asbestos Work Area.

1.2.21 Polyethylene: Sheeting of type and thickness specified sealed with tape along all edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealant, and to prevent escape of asbestos fibres through the sheeting into a clean area.

1.2.22 Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

1.2.23 Type 1 Asbestos Operations: Defined by Ontario Regulation 278/05, Section 12, includes the following operations:

1.2.23.1 Installing or removing ceiling tiles that are asbestos-containing material, if the tiles cover an area less than 7.5 square metres and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

1.2.23.2 Installing or removing non-friable asbestos-containing material, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

1.2.23.3 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if,

1.2.23.3.1 the material is wetted to control the spread of dust or fibres, and

1.2.23.3.2 the work is done only by means of non-powered hand-held tools.

1.2.23.4 Removing less than one square metre of drywall in which joint-filling compounds that are asbestos-containing material have been used.

1.2.23.5 Work on ceiling tiles, drywall or friable asbestos-containing material is classified according to the total area on which work is done consecutively in a room or enclosed area, even if the work is divided into smaller jobs.

1.2.24 Wet Cleaning: The process of eliminating asbestos contamination from Facility surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of as asbestos-contaminated waste.

1.2.25 Work: Includes all services, labour and material required to complete the work as specified in the contract.

1.3 Worker Protection

1.3.1 Prior to commencing work instruct workers in all aspects of work procedures and protective measures.

1.3.2 Provide workers who request a respirator with personally issued respiratory equipment acceptable to the Occupational Health and Safety Division of the Ontario Ministry of Labour, suitable for the Asbestos exposure.

1.3.3 Ensure that suitable respiratory protective equipment is worn by every worker, who has requested a respirator, and who enters the Asbestos Work Area. A respirator provided by an employer and used by a worker shall be:

1.3.3.1 One of the following types depending on the classification of work and method removal;

1.3.3.1.1 Air purifying full-facepiece respirator with N-100, R-100 or P-100 particulate filters;

1.3.3.1.2 Powered air purifying respirator equipped with a tight-fitting facepiece (half or full-facepiece) and a high efficiency filter or N-100, R-100 or P-100 particulate filters;

1.3.3.1.3 Negative pressure (demand) supplied air respirator equipped with a full-facepiece;

1.3.3.1.4 Continuous flow supplied air respirator equipped with a tight fitting facepiece (half or full-facepiece);

1.3.3.2 fitted so that there is an effective seal between the respirator and the worker's face;

1.3.3.3 assigned to a worker for the worker's exclusive use, if practicable;

1.3.3.4 used and maintained in accordance with written procedures that are established by the employer and are consistent with the manufacturer’s specifications;

1.3.3.5 cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker;

1.3.3.6 free of damaged or deteriorated parts. Damaged or deteriorated parts are to be replaced prior to being used by a worker;

1.3.3.7 be stored in a convenient, clean and sanitary location; when not in use;

1.3.3.8 certified by the US National Institute for Occupational Safety and Health (NIOSH) for exposure to airborne asbestos fibre.

1.3.4 If respirators are used in the workplace,

1.3.4.1 The employer shall establish written procedures regarding the selection, use and care of respirators; and

1.3.4.2 A copy of the procedures shall be provided to and reviewed with each worker who is required to wear a respirator.

1.3.5 A worker shall not be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

1.3.6 Provide workers who request protective clothing with full body disposable coveralls.

1.3.7 Ensure that full body disposable coveralls are worn by every worker, who has requested protective clothing, and who enters the Asbestos Work Area. The protective clothing provided by an employer and used by a worker shall be:

1.3.7.1 made of a material which does not readily retain nor permit penetration of asbestos fibres;

1.3.7.2 shall consist of head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing;

1.3.7.3 shall include suitable footwear;

1.3.7.4 shall be repaired or replaced if torn.

1.3.8 Do not eat, drink, smoke or chew except in established locations outside the Asbestos Work Area.

1.4 Visitor Protection

1.4.1 Provide clean protective clothing and equipment and approved respirators to Authorized Visitors when requested.

1.4.2 Ensure Authorized Visitors have received required training for entry into Asbestos Work Area.

1.5 Air Monitoring

1.5.1 Air monitoring may be performed following the National Institute for Occupational Safety and Health method 7400.

1.5.2 The contractor shall cooperate fully with the asbestos abatement consultant in the collection of air monitoring samples, including the collection of personal worker samples, if required.

1.5.3 If samples are collected, results of PCM samples of 0.04 fibres per millilitre of air (fibre/mL) or greater, outside of Asbestos Work Area, will indicate asbestos contamination of these areas. The contaminated areas shall be isolated and cleaned in the same manner applicable to the Asbestos Work Area, at no cost to the Owner.

2. PRODUCTS

2.1 Materials and Equipment

2.1.1 All tools, equipment, materials and supplies brought to work site must be in good condition and free of asbestos, asbestos debris, and fibrous materials.

2.1.2 Disposable tools, equipment, materials and supplies must be of new materials only.

2.1.3 Asbestos Waste Containers: Containers for dust and waste shall be, dust tight, suitable for the type of waste, impervious to asbestos and any chemicals used during the removal process, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before being removed from the work area, and removed from the workplace frequently and at regular intervals.

2.1.3.1 Waste shall be contained in two separate containers. The inner container shall be a sealable polyethylene bag. Where there are sharp objects included in the waste material, the outer container shall be a sealable fibre type drum, otherwise the outer container may be a sealable polyethylene bag.

2.1.3.2 Container must be new materials only.

2.1.3.3 Containers shall be as follows:

2.1.3.3.1 Polyethylene Waste Bag: 0.15 mm (6 mil) thick leak-tight polyethylene bags.

2.1.3.3.2 Fibre Drums: 55 US gallon capacity heavy-duty leak tight fibre drums with tight sealing locking metal top and metal bottom.

2.1.3.3.3 Labels: Waste containers shall have a pre-printed cautionary asbestos warning label, acceptable to local dump Governmental Authorities, clearly visible when ready for removal to disposal site.

2.1.4 Drop Sheets: In polyethylene type and size appropriate for the work being performed.

2.1.5 First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry.

2.1.6 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. All air must be filtered by HEPA filter before discharge.

2.1.7 Lockdown Sealer: Slow-drying sealer shall be a non-staining, clear, water dispersable type that remains tacky on the surface for a minimum of 8 hours for the purpose of trapping any residual airborne fibres during the settling period. Lock-down agent shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. The product must have flame spread and smoke development ratings both less than 50 and shall leave no stain when dry. Also referred to as “Lockdown Agent”.

2.1.8 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.

2.1.8.1 Fibre-Reinforced (Rip-Proof) Polyethylene Sheeting: 8 mil (0.20mm) fabric made up from one layer of 5 mil (0.13 mm) weave and two layers of 1.5 mil (0.04 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.

2.1.9 Protective Coveralls: Disposable full body coveralls complete with hoods manufactured of a material which does not permit penetration of asbestos fibres.

2.1.10 Sprayer: Garden-type portable manual sprayer or water hose with spray attachment if suitable.

2.1.11 Tape: Reinforced cloth or fibreglass reinforced tape, or vinyl tape, in 2" or 3" widths suitable for sealing polyethylene sheeting under both wet conditions using amended water, and dry conditions.

3. EXECUTION

3.1 Site Preparation

3.1.1 Establish personal hygiene facilities for workers to wash their hands and face. Washing facilities to include sufficient supplies of disposable hand towels, hand soap, a waste receptacle and a mirror.

3.1.2 Provide to the Asbestos Abatement Consultant an itemized list of pre-existing damage in Work Area.

3.1.3 Moving of equipment, tools, supplies, and stored materials which can be performed without disturbing ACM will be performed by the contractor.

3.1.4 Visible dust shall be removed with a damp cloth/mop or a vacuum equipped with a HEPA filter from any surface in the work area, including the thing to be worked on, if the dust on that surface is likely to be disturbed.

3.1.5 The spread of debris and dust from the work area shall be controlled by measures appropriate to the work to be done including the use of drop sheets of fibre-reinforced (rip-proof) polyethylene or other suitable material that is impervious to asbestos. Replace, or overlay, additional layers of fibre reinforced (rip-proof) polyethylene sheeting as required to maintain an efficient and continuous barrier.

3.1.6 In the case of the removal of less then one square meter of drywall with asbestos-containing drywall joint compound, the material shall be wetted before and kept wet during the work to control the spread of dust or fibres, unless wetting would create a hazard or cause damage.

3.1.7 Prepare sufficient quantities of water mixed with a wetting agent, which is to be used frequently and at regular intervals, to control the spread of debris and dust.

3.1.8 Cover floors and furnishings with polyethylene sheeting or Rip-Proof Polyethylene Sheeting before disturbing non-friable ACM.

3.2 Removal

3.2.1 Prior to removal, wet all materials scheduled for removal. Allow materials scheduled for removal sufficient time to absorb wetting agent.

3.2.2 All removal work must be completed manually with non-powered hand tools.

3.2.3 Undo or remove fasteners if necessary to remove materials.

3.2.4 Break materials only if unavoidable.

3.2.5 Wet freshly exposed edges of broken materials.

3.2.6 Remove material adhered to substrate or supports.

3.2.7 Frequently and at regular intervals during the doing of the work, debris and dust waste shall be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in an asbestos waste container.

3.2.8 Clean Asbestos Work Area frequently with HEPA vacuum or with wet cleaning methods.

3.2.9 Compressed air shall not be used to clean up and remove debris or dust from any surface.

3.2.10 Eating, drinking, chewing or smoking shall not be permitted in the work area.

3.2.11 Maintain all work areas in a neat and orderly fashion at all times.

3.3 Work Area Clean Up and Exit from the Work Area

3.3.1 Immediately upon completion of the work, debris and dust waste shall be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in an asbestos waste container.

3.3.2 Following visual acceptance of the removal work, by the Asbestos Abatement Consultant, spray the entire surface, where ACM have been removed, with lock-down sealer.

3.3.3 Drop sheets shall not be reused.

3.3.4 Drop sheets shall be wetted and placed in an asbestos waste container as soon as practicable after completion of the preceding Items of this Section.

3.3.5 Carefully roll drop sheets toward the centre of work area. Remove visible debris by means of HEPA vacuum as polyethylene is rolled away.

3.3.6 After the work is completed, polyethylene sheeting and similar materials used for barriers and enclosures shall not be reused, but shall be wetted and placed in an asbestos waste container as soon as practicable following completion of the preceding Items of this Section.

3.3.7 Barriers and portable enclosures shall not be reused unless they are rigid and can be cleaned thoroughly.

3.3.8 After the work is completed, barriers and portable enclosures that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp

wiping, as soon as practicable following completion of the preceding Items of this Section.

3.3.9 All tools, equipment, materials and supplies that will NOT be reused shall be placed in an asbestos waste container as soon as practicable following completion of the preceding Items of this Section.

3.3.10 All tools, equipment, materials and supplies that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp wiping, as soon as practicable following completion of the preceding Items of this Section.

3.3.11 Workers who are provided with protective clothing shall complete the following before leaving the work area;

3.3.11.1 Decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing.

3.3.11.2 If the protective clothing is to be reused, it shall be stored in a sealable plastic bag.

3.3.11.3 If the protective clothing will NOT be reused, place it in an asbestos waste container immediately prior to leaving the work area.

3.3.12 Immediately after leaving the work area, all workers shall proceed directly to the established washing facilities to wash hands and face.

3.3.13 All workers who requested respiratory protection shall wash, remove and store respirators as per the written procedures that have been established by the employer and as is consistent with the manufacturer's specifications.

3.3.14 Reinstall objects and items removed to facilitate removal of ACM.

End of Section

LIST OF CONTENTS

Page

1. GENERAL 2

1.1 General And Related Work 2
1.2 Definitions 3
1.3 Worker Protection 6
1.4 Visitor Protection 8
1.5 Air Monitoring 8

2. PRODUCTS 8

2.1 Materials and Equipment 8

3. EXECUTION 11

3.1 Preparation Prior to Contamination 11
3.2 Asbestos Removal 12
3.3 Teardown of Enclosure and Exit from the Work Area 14

1. GENERAL

1.1 General And Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere

Division 2	Section 02 82 00	Abatement Scope and Details
Division 2	Section 02 82 01	Type 1 Asbestos Abatement
Division 2	Section 02 82 04	Type 3 Asbestos Abatement
Division 2	Section 02 83 00	Lead Abatement
Division 2	Section 02 83 10	Other Hazardous Materials
Division 2	Section 02 84 00	PCB Capacitors and Ballasts

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 This specification fulfils the requirements of the report required by Designated Substance – *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, Ontario Regulation 278/05, Section 10.

1.1.4 The Contractor is responsible to verify all measurements for removal, cleaning, and re-insulation purposes. Measurements and quantities provided herein are for reference only.

1.1.5 It is the intent that work performed as per this section will result in the removal and disposal or decontamination of all asbestos-containing material (ACM) and mould-contaminated materials, as well as all materials that have been contaminated by ACM or mould either during or prior to work of this section.

1.1.6 Refer to Section 02 82 00, Abatement Scope and Details, for the following information and requirements;

1.1.6.1 Site Conditions,

1.1.6.2 Outline of Work,

1.1.6.3 Schedule,

1.1.6.4 Supervision,

1.1.6.5 Quality Assurance,

1.1.6.6 Regulations,

1.1.6.7 Notification,

1.1.6.8 Submittals, and

1.1.6.9 Waste Transport And Disposal.

1.2 Definitions

1.2.1 Airlock: A system for permitting ingress or egress without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways at least 1.5 m apart.

1.2.2 Air Monitoring: The process of measuring the fibre content of a specific volume of air.

1.2.3 Amended Water: Water with a non-ionic surfactant wetting agent added to reduce water surface tension to 35 or less dynes, to allow thorough wetting of asbestos fibres.

1.2.4 Asbestos: The serpentine and amphibole asbestiform varieties including chrysotile, actinolite, amosite, anthophyllite, crocidolite and tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.

1.2.5 Asbestos Abatement Consultant: The Owner or person designated by the owner to provide inspection and air monitoring of the Contractor's work.

1.2.6 Asbestos-Containing Material (ACM): Any material that contains 0.5 per cent or more asbestos, of any type or mixture of types, by dry weight.

1.2.7 Asbestos-Containing Waste Material: Any material which is or is suspected of being or any material contaminated with an asbestos-containing material which is to be removed from a work area for disposal.

1.2.8 Asbestos Debris: Pieces of ACM that can be identified by colour, texture, or composition, or means dust, if the dust is determined by an accredited Asbestos Abatement Consultant to be ACM.

1.2.9 Asbestos Work Area: Where the actual removal, sealing and enclosure of asbestos-containing materials takes place.

1.2.10 Authorized Visitor: The Owner or his approved representative and/or persons representing regulatory agencies.

1.2.11 Barrier: Any surface that seals off the work area to inhibit the movement of fibres.

1.2.12 Clean Area: Either an operating area or an area in which removal work has already been completed.

1.2.13 Curtained Doorway: An arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed by placing two overlapping sheets of polyethylene over an existing or temporarily framed doorway, securing each along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. All free edges of polyethylene shall be reinforced with duct tape and the bottom edge shall be weighted to ensure proper closing. Each polyethylene sheet shall overlap openings not less than 1.5 m on each side.

1.2.14 Demolition: The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.

1.2.15 Disposal Bag: A properly labelled 6 mil thick leak-tight plastic bag used for transporting asbestos waste from the work area to the disposal site.

1.2.16 DOP / PAO Test: Dioctylphthalate / Poly Alpha Olefin aerosol challenge of a HEPA filter system and is used to establish the integrity and effectiveness of the system to filter out asbestos fibres.

1.2.17 Encapsulant: A material that surrounds or embeds asbestos fibres in an adhesive matrix, to prevent release of fibres.

1.2.17.1 Bridging Encapsulant: An encapsulant that forms a discrete layer on the surface of an in situ asbestos matrix.

1.2.17.2 Penetrating Encapsulant: An encapsulant that is absorbed by the in situ asbestos matrix without leaving a discrete surface layer.

1.2.17.3 Removal Encapsulant: A penetrating encapsulant specifically designed to minimize fibre release during removal of asbestos-containing materials rather than for in situ encapsulation.

1.2.18 Encapsulation: Applying an encapsulant to asbestos-containing materials.

1.2.19 Enclosure: 6 mil polyethylene sheeting installed to fully isolate the Type 2 Asbestos Work Area. Enclosure may be a prefabricated self supporting structure or constructed with a rigid frame, or, when applicable, supported by the ceiling grid. Enclosure shall have polyethylene sheeting as a top at locations where the enclosure does not extend up to the underside of the ceiling or underside of structure.

1.2.20 Filter: A media component used in respirators, vacuum cleaners or negative pressure filter fan units to remove solid or liquid particles from the inspired air.

1.2.21 Fitting: Unless otherwise described in Site Conditions, all connections of a pipe which include elbows, ends, caps, valves, hangers, tees and unions, etc.

1.2.22 Friable Asbestos Material: Material that contains asbestos that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.23 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.

1.2.24 Negative Pressure: A system which extracts air directly from the work area, filters such extracted air through a High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building. This system shall maintain a minimum pressure differential of 0.02 inches Water Gauge relative to adjacent areas outside of work areas, be equipped with an alarm to warn of system breakdown (i.e. excessive negative pressure or insufficient negative pressure), and be equipped with an instrument to continuously monitor and automatically record pressure differences.

1.2.25 Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

1.2.26 Occupied Area: Any area of the building outside the Asbestos Work Area.

1.2.27 Polyethylene: Sheeting of type and thickness specified sealed with tape along all edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealant, and to prevent escape of asbestos fibres through the sheeting into a clean area.

1.2.28 Positive Pressure Respirator: A respirator in which the air pressure inside the respiratory inlet covering is positive during inhalation and exhalation in relation to the air pressure of the outside atmosphere.

1.2.29 Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

1.2.30 Straight run pipes: Part of the building system not included under the description of Fitting, including but not limited to straight, angled or curved sections of pipe, pumps, headers and reducers.

1.2.31 Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

1.2.32 Type 2 Asbestos Operations: Defined by Ontario Regulation 278/05, Section 12, includes the following operations:

1.2.32.1 Removing all or part of a false ceiling to obtain access to a work area, if asbestos-containing material is likely to be lying on the surface of the false ceiling.

1.2.32.2 The removal or disturbance of one square metre or less of friable asbestos-containing material during the repair, alteration, maintenance or demolition of all or part of machinery or equipment or a building, aircraft, locomotive, railway car, vehicle or ship.

1.2.32.3 Enclosing friable asbestos-containing material.

1.2.32.4 Applying tape or a sealant or other covering to pipe or boiler insulation that is asbestos-containing material.

1.2.32.5 Installing or removing ceiling tiles that are asbestos-containing material, if the tiles cover an area of 7.5 square metres or more and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

1.2.32.6 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if,

1.2.32.6.1 the material is not wetted to control the spread of dust or fibres, and

1.2.32.6.2 the work is done only by means of non-powered hand-held tools.

1.2.32.7 Removing one square metre or more of drywall in which joint filling compounds that are asbestos-containing material have been used.

1.2.32.8 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.

1.2.32.9 Removing insulation that is asbestos-containing material from a pipe, duct or similar structure using a glove bag.

1.2.32.10 Cleaning or removing filters used in air handling equipment in a building that has sprayed fireproofing that is asbestos-containing material.

1.2.32.11 An operation that,

1.2.32.11.1 is not mentioned in any of paragraphs 1 to 10

1.2.32.11.2 may expose a worker to asbestos, and

1.2.32.11.3 is not classified as a Type 1 or Type 3 operation.

1.2.32.12 Work on ceiling tiles, drywall or friable asbestos-containing material is classified according to the total area on which work is done consecutively in a room or enclosed area, even if the work is divided into smaller jobs.

1.2.33 Water Filtration System: A multi-stage filtration system for filtering shower and wastewater. Typically constructed with at least two filters, the primary stage retains 20 microns or larger particles and the final stage removes 5 micron or larger particles.

1.2.34 Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of as asbestos-contaminated waste.

1.2.35 Work: Includes all services, labour and material required to complete the work as specified in the contract.

1.3 Worker Protection

1.3.1 Prior to commencing work instruct workers in all aspects of work procedures and protective measures.

1.3.2 Provide workers a respirator with personally issued respiratory equipment acceptable to the Occupational Health and Safety Division of the Ontario Ministry of Labour, suitable for the Asbestos exposure.

1.3.3 Ensure that suitable respiratory protective equipment is worn by every worker who enters the Asbestos Work Area. A respirator provided by an employer and used by a worker shall be:

1.3.3.1 One of the following types depending on the classification of work and method removal;

1.3.3.1.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filters;

1.3.3.1.2 Air purifying full-facepiece respirator with N-100, R-100 or P-100 particulate filters;

1.3.3.1.3 Powered air purifying respirator equipped with a tight-fitting facepiece (half or full-facepiece) and a high efficiency filter or N-100, R-100 or P-100 particulate filters;

1.3.3.1.4 Negative pressure (demand) supplied air respirator equipped with a full-facepiece;

1.3.3.1.5 Continuous flow supplied air respirator equipped with a tight fitting facepiece (half or full-facepiece);

1.3.3.1.6 Pressure demand supplied air respirator equipped with a half or full-facepiece mask;

1.3.3.2 fitted so that there is an effective seal between the respirator and the worker's face;

1.3.3.3 assigned to a worker for the worker's exclusive use if practicable;

1.3.3.4 used and maintained in accordance with written procedures that are established by the employer and are consistent with the manufacturer's specifications;

1.3.3.5 cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker;

1.3.3.6 free of damaged or deteriorated parts. Damaged or deteriorated parts are to be replaced prior to being used by a worker;

1.3.3.7 be stored in a convenient, clean and sanitary location; when not in use;

1.3.3.8 certified by the US National Institute for Occupational Safety and Health (NIOSH) for exposure to airborne asbestos fibre.

1.3.4 The employer shall establish written procedures regarding the selection, use and care of respirators.

1.3.5 A copy of the procedures shall be provided to and reviewed with each worker.

1.3.6 A worker shall not be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

1.3.7 Provide all workers with full body disposable coveralls.

1.3.8 Ensure that full body disposable coveralls are worn by every worker who enters the Asbestos Work Area. The protective clothing provided by an employer and used by a worker shall be:

1.3.8.1 made of a material which does not readily retain nor permit penetration of asbestos fibres;

1.3.8.2 shall consist of head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing;

1.3.8.3 shall include suitable footwear;

1.3.8.4 shall be repaired or replaced if torn.

1.3.9 Provide other body protection required under applicable safety regulations.

1.3.10 Personnel must be fully protected at all times when possibility of disturbance of asbestos exists.

1.3.11 Provide and post the procedures described under Worker Protection.

1.3.12 Do not eat, drink, smoke or chew except in established locations outside the Asbestos Work Area.

1.3.13 Asbestos Abatement Work Area Entry Procedures

1.3.13.1 Use asbestos abatement precautions at all times when possibility of disturbance of ACM exists.

1.3.13.2 Put on respirator with new or tested filters, coveralls and head covers before entering contaminated Asbestos Work Area. Protective coveralls shall cover all hair and any re-usable clothing.

1.3.14 Asbestos Abatement Work Area Exit Procedures

1.3.14.1 Remove gross contamination from protective clothing using HEPA vacuum or wet wiping.

1.3.14.2 Remove all contaminated clothing and equipment except respirator.

1.3.14.3 Exit site and proceed to wash area while wearing respirator.

1.3.14.4 Wash exposed skin and respirator with soap and water.

1.3.14.5 Remove respirator filters from respirator. Cover inlet side of respirator with tape for storage and re-use or dispose of as asbestos waste.

1.4 Visitor Protection

1.4.1 Provide clean protective clothing and equipment and approved respirators to Authorized Visitors.

1.4.2 Ensure Authorized Visitors have received required training for entry into Asbestos Work Area.

1.5 Air Monitoring

1.5.1 Air monitoring will be performed following the National Institute for Occupational Safety and Health method 7400.

1.5.2 The contractor shall cooperate fully with the asbestos abatement consultant in the collection of air monitoring samples, including the collection of personal worker samples, if required.

1.5.3 Results of PCM samples of 0.04 fibres per millilitre of air (fibre/mL) or greater, outside of Asbestos Work Area, will indicate asbestos contamination of these areas. The contaminated areas shall be isolated and cleaned in the same manner applicable to the Asbestos Work Area, at no cost to the Owner.

2. PRODUCTS

2.1 Materials and Equipment

2.1.1 All tools, equipment, materials and supplies brought to work site must be in good condition and free of asbestos, asbestos debris, and fibrous materials.

2.1.2 Disposable tools, equipment, materials and supplies must be of new materials only.

2.1.3 Airless Sprayer: Spray equipment for amended water: for application to asbestos-containing materials for saturation prior to removal. Airless spray units are only acceptable, such as Grace Hydrospray or approved equal.

2.1.4 Asbestos Waste Containers: Containers for dust and waste shall be, dust tight, suitable for the type of waste, impervious to asbestos and any chemicals used during the removal process, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before being removed from the work area, and removed from the workplace frequently and at regular intervals.

2.1.4.1 Waste shall be contained in two separate containers. The inner container shall be a sealable polyethylene bag (or where the glove bag method is used, the glove bag itself). Where there are sharp objects included in the waste material, the outer container shall be a sealable fibre type drum, otherwise the outer container may be a sealable polyethylene bag.

2.1.4.2 Container must be new materials only.

2.1.4.3 Containers shall be as follows:

2.1.4.3.1 Polyethylene Waste Bag: 0.15 mm (6 mil) thick leak-tight polyethylene bags.

2.1.4.3.2 Fibre Drums: 55 US gallon capacity heavy duty leak tight fibre drums with tight sealing locking metal top and metal bottom.

2.1.4.3.3 Labels: Waste containers shall have a pre-printed cautionary asbestos warning label, acceptable to local dump authorities, clearly visible when ready for removal to disposal site.

2.1.5 Caulking: One component non-staining acrylic polymer sealant to conform to GSB Specification 19GP-5M.

2.1.6 Drop Sheets: In polyethylene type and size appropriate for the work being performed.

2.1.7 Electrical Power Cords: Use only grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas of work.

2.1.8 Encapsulant: Type 1 penetrating Class A water based encapsulant conforming to CGSB 1-GP-205M and approved by the Fire Marshall having flame spread and smoke development ratings both less than fifty (50). Acceptable products: Ocean 666, Decadex Fire Check equivalent or better.

2.1.9 Fine Atomizing Spray Nozzle: Nozzle for airless sprayer capable of delivering not less than 1 gallon per minute of fine particle spray of amended water.

2.1.10 First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry.

2.1.11 Flame-Resistant Polyethylene Sheeting: A single polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard

701, Small Scale Fire Test for Flame-Resistant Textiles and Films, 0.15 mm (6 mils) thickness.

2.1.12 Garden Sprayer: A hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or fine spray of liquid of amended water under pressure.

2.1.13 Ground Fault Panel: Electrical panel, installed by licensed electrician and equipped as follows:

2.1.13.1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.

2.1.13.2 Interrupters to have a 5 mA ground fault protection.

2.1.13.3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.

2.1.13.4 Openings sealed to prevent moisture or dust penetration.

2.1.14 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. All air must be filtered by HEPA filter before discharge.

2.1.15 Lockdown Sealer: Slow-drying sealer shall be a non-staining, clear, water dispersable type that remains tacky on the surface for a minimum of 8 hours for the purpose of trapping any residual airborne fibres during the settling period. Lock-down agent shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. The product must have flame spread and smoke development ratings both less than 50 and shall leave no stain when dry. Also referred to as “Lockdown Agent”.

2.1.16 Negative Air Unit: Portable air handling system which extracts air directly from the Asbestos Work Area and discharges the air to the exterior of the Asbestos Work Area. Equipped as follows:

2.1.16.1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.

2.1.16.2 Pressure differential gauge to monitor filter loading.

2.1.16.3 Auto shut off and warning system for HEPA filter failure.

2.1.16.4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.

2.1.17 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.

2.1.17.1 Fibre-Reinforced (Rip-Proof) Polyethylene Sheeting: 8 mil (0.20mm) fabric made up from one layer of 5 mil (0.13 mm) weave and two layers of 1.5 mil (0.04 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.

2.1.17.2 Flame-Resistant Polyethylene Sheeting: A single polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films, 6 mil (0.15 mm) thickness.

2.1.18 Power Washer: Spray equipment for saturation of asbestos-containing material with amended water for cleaning of surfaces in abatement work area after asbestos removal, capable of delivering an airless stream of water at a pressure of not less than 1200 psi or exceeding 2500 psi.

2.1.19 Protective Coveralls: Disposable full body coveralls complete with hoods manufactured of a material which does not permit penetration of asbestos fibres.

2.1.20 Scaffolding: The type, erection and use of all scaffolding shall comply with all applicable OHSA provisions.

2.1.21 Spray Cement: Spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

2.1.22 Tape: Reinforced cloth or fibreglass reinforced tape, or vinyl tape, in 2" or 3" widths suitable for sealing polyethylene sheeting under both wet conditions using amended water, and dry conditions.

2.1.23 Temporary Lighting: Provide general service incandescent lamps or fluorescent lamps of wattage required for adequate illumination as required by the work. Protect lamps with guard cages grounded together to distribution panel or tempered glass enclosures.

2.1.24 Wetting Agent: Non-sudsing surface active agent. Acceptable product Aqua-Gro or approved equal.

3. EXECUTION

3.1 Preparation Prior to Contamination

3.1.1 Establish personal hygiene facilities for workers to wash their hands and face. Washing facilities to include sufficient supplies of disposable hand towels, hand soap, a waste receptacle and a mirror.

3.1.2 Visible dust shall be removed with a damp cloth/mop or a vacuum equipped with a HEPA filter from any surface in the work area, including the thing to be worked on, if the dust on that surface is likely to be disturbed.

3.1.3 Provide to the Asbestos Abatement Consultant an itemized list of pre-existing damage in Work Area.

3.1.4 Moving of equipment, tools, supplies, and stored materials which can be performed without disturbing ACM will be performed by the contractor.

3.1.5 Disable air handling system affecting Asbestos Work Area. Seal ventilation ducts to and from the work area. The air handling system shall not be enabled until completion of work.

3.1.6 Shut off and lock out electrical power within the enclosure.

3.1.7 For operations requiring either 1) removing all or part of a false ceiling to obtain access to a work area, if ACM is likely to be lying on the surface of the false ceiling, or 2) the removal or disturbance of one square metre of less of friable ACM, and where the enclosure is prepared with opaque materials (i.e. orange rip-proof polyethylene), the enclosure shall include one or more transparent

(clear) window areas to allow observation of the entire work area from outside the enclosure.

3.1.8 Erect polyethylene hoarding walls between Occupied Area and Work Area to create the Asbestos Work Area Enclosure. Construct a frame for the enclosure from 50 mm x 100 mm (2" x 4") construction grade wood studs and polyethylene. If the potential exists for the disturbance of ACM during the construction of the enclosure, wear a respirator and suitable protective clothing; ensure that the enclosure is of adequate size to permit the storage of equipment and waste.

3.1.9 Support polyethylene sheeting enclosures as required or as directed by Asbestos Abatement Consultant.

3.1.10 Seal all below deck openings, including opening at the deck, to the work area using polyethylene, spray adhesive, tape, caulking, etc.

3.1.11 Provide a sealed polyethylene top for free standing enclosures.

3.1.12 Enclosure may be supported from the deck system(s), if applicable.

3.1.13 Install temporary lighting as required in Asbestos Work Area Enclosure.

3.1.14 Cover floor and wall surfaces and other articles inside enclosure or forming the enclosure with polyethylene sheeting. Lay floor sheeting first and return up wall surface in a fashion that wall sheeting will overlap by at least 12".

3.1.15 Overlap perimeter polyethylene to form flap doorway.

3.1.16 Construct a transfer room for entry to and exit from the enclosure when it is necessary to move workers or materials between Occupied Areas and the Asbestos Work Area.

3.1.17 Establish negative pressure in Asbestos Work Areas as follows:

3.1.17.1 Use HEPA Vacuum, or HEPA Negative Air Unit if requested by the Asbestos Abatement Consultant, which has been DOP tested.

3.1.17.2 Insert vacuum hose into Enclosure. Provide enough hose to reach all areas of Enclosure.

3.1.17.3 Operate HEPA vacuum continuously until dismantling of Enclosure.

3.1.17.4 Provide sufficient negative air pressure to exchange a volume of air equivalent to that of the Asbestos Work Area a minimum of every 20 minutes.

3.1.18 Post signs at doorways leading into a contaminated area.

Such signs shall read:

CAUTION
Asbestos Hazard Area
No Unauthorized Entry
Wear assigned protective equipment
Breathing asbestos dust may cause serious bodily harm

3.2 <u>Asbestos Removal</u>

3.2.1 Before beginning work, remove visible dust from surfaces in the work area. Use HEPA vacuum, or damp cloths where damp cleaning is considered more appropriate. The use of compressed air is strictly forbidden.

3.2.2 All removal work must be completed manually with non-powered hand tools.

3.2.3 Undo or remove fasteners if necessary to remove materials.

3.2.4 Wet materials containing asbestos to be removed, disturbed, or sealed, with amended water. Use garden type low velocity fine mist sprayer. Perform work in a manner to reduce the creation and spread of dust. Keep material wetted as work proceeds and as additional layers of material are exposed.

3.2.5 Break materials only if unavoidable.

3.2.6 Wet freshly exposed edges of broken materials.

3.2.7 Remove material adhered to substrate or supports.

3.2.8 Place waste directly into waste disposal bags. Wherever possible, asbestos-containing material should be removed in sections as intact as possible. Do not allow material to fall to floor.

3.2.9 Frequently and at regular intervals during the doing of the work, debris and dust waste shall be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in an asbestos waste container.

3.2.10 Clean surfaces where asbestos has been removed by means of wire brushes, steel wool, or other suitable tools.

3.2.11 Immediately after completion of the work, clean up dust and waste containing asbestos using a HEPA vacuum or by damp wiping.

3.2.12 Double bag all waste as it is taken out of the Asbestos Work Area Enclosure.

3.2.13 Clean the entire Asbestos Work Area by means of HEPA vacuuming or wet wiping when removal of ACM is complete.

3.2.14 All tools, equipment, materials and supplies that will NOT be reused shall be placed in an asbestos waste container as soon as practicable following completion of the preceeding Items of this Section.

3.2.15 All tools, equipment, materials and supplies that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp wiping, as soon as practicable following completion of the preceding Items of this Section.

3.2.16 Place materials used to form Enclosure, disposable coveralls, and other contaminated waste in asbestos waste bags for disposal. All waste is to be double bagged and independently sealed.

3.2.17 Apply a heavy coat of sealant using a fine mist sprayer to all surfaces in the work area.

3.2.18 The Enclosure shall remain erected until the sealant has dried or, if required, until an air sample is collected inside the enclosure, and the levels are below 0.04f/cc.

3.2.19 Compressed air shall not be used to clean up and remove debris or dust from any surface.

3.2.20 Eating, drinking, chewing or smoking shall not be permitted in the work area.

3.2.21 Maintain all work areas in a neat and orderly fashion at all times.

3.3 Teardown of Enclosure and Exit from the Work Area

3.3.1 Carefully roll polyethylene toward the centre of enclosure. Remove visible debris by means of HEPA vacuum as polyethylene is rolled away.

3.3.2 Drop sheets shall not be reused.

3.3.3 Drop sheets shall be wetted and placed in an asbestos waste container as soon as practicable after completion of the preceding Items of this Section.

3.3.4 After the work is completed, polyethylene sheeting and similar materials used for barriers and enclosures shall not be reused, but shall be wetted and placed in an asbestos waste container as soon as practicable following completion of the preceeding Items of this Section.

3.3.5 Barriers and portable enclosures shall not be reused unless they are rigid and can be cleaned thoroughly.

3.3.6 After the work is completed, barriers and portable enclosures that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp wiping, as soon as practicable following completion of the preceeding Items of this Section.

3.3.7 Prior to leaving the work area, workers shall decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing.

3.3.7.1 If the protective clothing is to be reused, it shall be stored in a sealable plastic bag.

3.3.7.2 If the protective clothing will NOT be reused, place it in an asbestos waste container immediately prior to leaving the work area.

3.3.8 Immediately after leaving the work area, all workers shall proceed directly to the established washing facilities to wash hands and face.

3.3.9 All workers shall wash, remove and store respirtors as per the written procedures that have been established by the employer and as is consistent with the manufacturer's specifications.

3.3.10 Reinstall objects and items removed to facilitate removal of ACM.

End of Section

LIST OF CONTENTS

Page

1. GENERAL 2

1.1 General And Related Work 2
1.2 Definitions 3
1.3 Worker Protection 6
1.4 Visitor Protection 8
1.5 Air Monitoring 8

2. PRODUCTS 8

2.1 Materials and Equipment 8

3. EXECUTION 12

3.1 Preparation Prior to Contamination 12
3.2 Contaminated Preparation 17
3.3 Work above Ceilings 17
3.4 Asbestos Removal 18
3.5 Application of Lock Down Agent 19
3.6 Asbestos Work Area Teardown And Dismantling 19
3.7 Re-establishment of Objects and Systems 21

1. GENERAL

1.1 General And Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere

Division 2	Section 02 82 00	Abatement Scope and Details
Division 2	Section 02 82 01	Type 1 Asbestos Abatement
Division 2	Section 02 82 02	Type 2 Asbestos Abatement
Division 2	Section 02 83 00	Lead Abatement
Division 2	Section 02 83 10	Other Hazardous Materials
Division 2	Section 02 84 00	PCB Capacitors and Ballasts

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 This specification fulfils the requirements of the report required by Designated Substance – *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, Ontario Regulation 278/05, Section 10.

1.1.4 The Contractor is responsible to verify all measurements for removal, cleaning, and re-insulation purposes. Measurements and quantities provided herein are for reference only.

1.1.5 It is the intent that work performed as per this section will result in the removal and disposal or decontamination of all asbestos-containing material (ACM) and mould-contaminated materials, as well as all materials that have been contaminated by ACM or mould either during or prior to work of this section.

1.1.6 Refer to Section 02 82 00, Abatement Scope and Details, for the following information and requirements;

1.1.6.1 Site Conditions,

1.1.6.2 Outline of Work,

1.1.6.3 Schedule,

1.1.6.4 Supervision,

1.1.6.5 Quality Assurance,

1.1.6.6 Regulations,

1.1.6.7 Notification,

1.1.6.8 Submittals, and

1.1.6.9 Waste Transport And Disposal.

1.2 Definitions

1.2.1 Airlock: A system for permitting ingress or egress without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways at least 1.5 m apart.

1.2.2 Air Monitoring: The process of measuring the fibre content of a specific volume of air.

1.2.3 Amended Water: Water with a non-ionic surfactant wetting agent added to reduce water surface tension to 35 or less dynes, to allow thorough wetting of asbestos fibres.

1.2.4 Asbestos: The serpentine and amphibole asbestiform varieties including chrysotile, actinolite, amosite, anthophyllite, crocidolite and tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.

1.2.5 Asbestos Abatement Consultant: The Owner or person designated by the owner to provide inspection and air monitoring of the Contractor's work.

1.2.6 Asbestos-Containing Material (ACM): Any material that contains 0.5 per cent or more asbestos, of any type or mixture of types, by dry weight.

1.2.7 Asbestos-Containing Waste Material: Any material which is or is suspected of being or any material contaminated with an asbestos-containing material which is to be removed from a work area for disposal.

1.2.8 Asbestos Debris: Pieces of ACM that can be identified by colour, texture, or composition, or means dust, if the dust is determined by an accredited Asbestos Abatement Consultant to be ACM.

1.2.9 Asbestos Work Area: Where the actual removal, sealing and enclosure of asbestos-containing materials takes place.

1.2.10 Authorized Visitor: The Owner or his approved representative and/or persons representing regulatory agencies.

1.2.11 Barrier: Any surface that seals off the work area to inhibit the movement of fibres.

1.2.12 Clean Area: Either an operating area or an area in which removal work has already been completed.

1.2.13 Curtained Doorway: An arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed by placing two overlapping sheets of polyethylene over an existing or temporarily framed doorway, securing each along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. All free edges of polyethylene shall be reinforced with duct tape and the bottom edge shall be weighted to ensure proper closing. Each polyethylene sheet shall overlap openings not less than 1.5 m on each side.

1.2.14 Demolition: The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.

1.2.15 Disposal Bag: A properly labelled 6 mil thick leak-tight plastic bag used for transporting asbestos waste from the work area to the disposal site.

1.2.16 DOP / PAO Test: Dioctylphthalate / Poly Alpha Olefin aerosol challenge of a HEPA filter system and is used to establish the integrity and effectiveness of the system to filter out asbestos fibres.

1.2.17 Encapsulant: A material that surrounds or embeds asbestos fibres in an adhesive matrix, to prevent release of fibres.

1.2.17.1 Bridging Encapsulant: An encapsulant that forms a discrete layer on the surface of an in situ asbestos matrix.

1.2.17.2 Penetrating Encapsulant: An encapsulant that is absorbed by the in situ asbestos matrix without leaving a discrete surface layer.

1.2.17.3 Removal Encapsulant: A penetrating encapsulant specifically designed to minimize fibre release during removal of asbestos-containing materials rather than for in situ encapsulation.

1.2.18 Encapsulation: Applying an encapsulant to asbestos-containing materials.

1.2.19 Enclosure: 6 mil polyethylene sheeting installed to fully isolate the Type 3 Asbestos Work Area. Enclosure may be a prefabricated self supporting structure or constructed with a rigid frame, or, when applicable, supported by the ceiling grid. Enclosure shall have polyethylene sheeting as a top at locations where the enclosure does not extend up to the underside of the ceiling or underside of structure

1.2.20 Filter: A media component used in respirators, vacuum cleaners or negative pressure filter fan units to remove solid or liquid particles from the inspired air.

1.2.21 Fitting: Unless otherwise described in Site Conditions, all connections of a pipe which include elbows, ends, caps, valves, hangers, tees and unions.

1.2.22 Friable Asbestos Material: Material that contains asbestos that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.23 Glovebag: A sack with inward projecting long sleeve gloves, which are designed to enclose an object from which an asbestos-containing material is to be removed.

1.2.24 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.

1.2.25 Negative Pressure: A system which extracts air directly from the work area, filters such extracted air through a High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building. This system shall maintain a minimum pressure differential of 0.02 inches Water Gauge relative to adjacent areas outside of work areas, be equipped with an alarm to warn of system breakdown (i.e. excessive negative pressure or insufficient negative pressure), and be equipped with an instrument to continuously monitor and automatically record pressure differences.

1.2.26 Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory-inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

1.2.27 Occupied Area: Any area of the building outside the Asbestos Work Area.

1.2.28 Polyethylene: Sheeting of type and thickness specified sealed with tape along all edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealant, and to prevent escape of asbestos fibres through the sheeting into a clean area.

1.2.29 Positive Pressure Respirator: A respirator in which the air pressure inside the respiratory inlet covering is positive during inhalation and exhalation in relation to the air pressure of the outside atmosphere.

1.2.30 Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

1.2.31 Straight run pipes: Part of the building system not included under the description of Fitting, including but not limited to straight, angled or curved sections of pipe, pumps, headers and reducers.

1.2.32 Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

1.2.33 Type 3 Asbestos Operations: Defined by Ontario Regulation 278/05, Section 12, includes the following operations:

1.2.33.1 The removal or disturbance of more than one square metre of friable asbestos-containing material during the repair, alteration, maintenance or demolition of all or part of a building, aircraft, ship, locomotive, railway car or vehicle or any machinery or equipment.

1.2.33.2 The spray application of a sealant to friable asbestos-containing material.

1.2.33.3 Cleaning or removing air handling equipment, including rigid ducting but not including filters, in a building that has sprayed fireproofing that is asbestos-containing material.

1.2.33.4 Repairing, altering or demolishing all or part of a kiln, metallurgical furnace or similar structure that is made in part of refractory materials that are asbestos-containing materials.

1.2.33.5 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material, if the work is done by means of power tools that are not attached to dust-collecting devices equipped with HEPA filters.

1.2.33.6 Repairing, altering or demolishing all or part of any building in which asbestos is or was used in the manufacture of products, unless the asbestos was cleaned up and removed before March 16, 1986.

1.2.33.7 Work on ceiling tiles, drywall or friable asbestos-containing material is classified according to the total area on which work is done consecutively in a room or enclosed area, even if the work is divided into smaller jobs.

1.2.34 Water Filtration System: A multi-stage filtration system for filtering shower and wastewater. Typically constructed with at least two filters, the primary stage retains 20 microns or larger particles and the final stage removes 5 micron or larger particles.

1.2.35 Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of as asbestos-contaminated waste.

1.2.36 Work: Includes all services, labour and material required to complete the work as specified in the contract.

1.3 Worker Protection

1.3.1 Prior to commencing work instruct workers in all aspects of work procedures and protective measures.

1.3.2 Provide workers a respirator with personally issued respiratory equipment acceptable to the Occupational Health and Safety Division of the Ontario Ministry of Labour, suitable for the Asbestos exposure.

1.3.3 Ensure that suitable respiratory protective equipment is worn by every worker who enters the Asbestos Work Area. A respirator provided by an employer and used by a worker shall be:

1.3.3.1 One of the following types depending on the classification of work and method removal;

1.3.3.1.1 Air purifying full-facepiece respirator with N-100, R-100 or P-100 particulate filters;

1.3.3.1.2 Powered air purifying respirator equipped with a tight-fitting facepiece (half or full-facepiece) and a high efficiency filter or N-100, R-100 or P-100 particulate filters;

1.3.3.1.3 Negative pressure (demand) supplied air respirator equipped with a full-facepiece;

1.3.3.1.4 Continuous flow supplied air respirator equipped with a tight fitting facepiece (half or full-facepiece);

1.3.3.1.5 Pressure demand supplied air respirator equipped with a half or full-facepiece mask;

1.3.3.2 fitted so that there is an effective seal between the respirator and the worker's face,

1.3.3.3 assigned to a worker for the worker's exclusive use,

1.3.3.4 used and maintained in accordance with the procedures specified by the equipment manufacturer,

1.3.3.5 cleaned, disinfected and inspected after use on each shift, or more often if necessary,

1.3.3.6 free of damaged or deteriorated parts replaced prior to being used by a worker,

1.3.3.7 be stored in a convenient, clean and sanitary location; when not in use,

1.3.3.8 certified by the US National Institute for Occupational Safety and Health (NIOSH) or the British Standards Institution for exposure to airborne asbestos fibre.

1.3.4 The employer shall establish written procedures regarding the selection, use and care of respirators.

1.3.5 A copy of the procedures shall be provided to and reviewed with each worker.

1.3.6 A worker shall not be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

1.3.7 Provide all workers with full body disposable coveralls.

1.3.8 Ensure that full body disposable coveralls are worn by every worker who enters the Asbestos Work Area. The protective clothing provided by an employer and used by a worker shall be:

1.3.8.1 made of a material which does not readily retain nor permit penetration of asbestos fibres;

1.3.8.2 shall consist of head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing;

1.3.8.3 shall include suitable footwear;

1.3.8.4 shall be repaired or replaced if torn.

1.3.9 Provide other body protection required under applicable safety regulations.

1.3.10 Personnel must be fully protected at all times when possibility of disturbance of asbestos exists.

1.3.11 Provide and post the procedures described under Worker Protection.

1.3.12 Do not eat, drink, smoke or chew except in established locations outside the Asbestos Work Area.

1.3.13 <u>Asbestos Abatement Work Area Entry Procedures</u>

1.3.13.1 Use asbestos abatement precautions at all times when possibility of disturbance of ACM exists.

1.3.13.2 Remove all clothing including undergarments and footwear in Clean Change Room.

1.3.13.3 Store all street clothes, uncontaminated footwear, towels, etc. in the Clean Change Room.

1.3.13.4 Put on respirator with new or tested filters, and coveralls in Clean Change Room.

1.3.13.5 Proceed into Asbestos Work area through the Shower Unit.

1.3.14 <u>Asbestos Abatement Work Area Exit Procedures</u>

1.3.14.1 Remove gross contamination from protective clothing using HEPA vacuum or wet wiping.

1.3.14.2 Proceed to Equipment and Access Room and remove all contaminated clothing and equipment except respirator.

1.3.14.3 Store contaminated footwear, hard hats, etc. in Equipment and Access Room.

1.3.14.4 Proceed naked to showers while still wearing respirator

1.3.14.5 While in shower, clean outside of respirator with soap and water. Thoroughly wet body, head and hair, remove respirator and wash body, head and hair. Wet clean inside and outside of respirator face piece

1.3.14.6 Cover inlet side of respirator filter(s) with tape prior to entering the Clean Change Room.

1.3.14.7 If the filters are to be discarded, remove from the respirator and dispose of as asbestos waste.

1.3.15 Proceed to the Clean Change Room, dry off and dress in street clothing.

1.4 Visitor Protection

1.4.1 Provide clean protective clothing and equipment and approved respirators to Authorized Visitors.

1.4.2 Ensure Authorized Visitors have received required training for entry into Asbestos Work Area.

1.5 Air Monitoring

1.5.1 Air monitoring will be performed following the National Institute for Occupational Safety and Health method 7400.

1.5.2 The contractor shall cooperate fully with the asbestos abatement consultant in the collection of air monitoring samples, including the collection of personal worker samples, if required.

1.5.3 Results of PCM samples of 0.04 fibres per millilitre of air (fibre/mL) or greater, outside of Asbestos Work Area, will indicate asbestos contamination of these areas. The contaminated areas shall be isolated and cleaned in the same manner applicable to the Asbestos Work Area, at no cost to the Owner.

1.5.4 Clearance air monitoring samples will be collected after a suitable settling period following application of lock-down agent. Clearance air monitoring will be completed following details of Subsection 18(5) of Ontario Regulation 278/05. All clearance air samples must not exceed 0.01 fibre/mL for the Work Area to be deemed clean.

2. PRODUCTS

2.1 Materials and Equipment

2.1.1 All tools, equipment, materials and supplies brought to work site must be in good condition and free of asbestos, asbestos debris, and fibrous materials.

2.1.2 Disposable tools, equipment, materials and supplies must be of new materials only.

2.1.3 Airless Sprayer: Spray equipment for amended water: for application to asbestos-containing materials for saturation prior to removal. Airless spray units are only acceptable, such as Grace Hydrospray or approved equal.

2.1.4 Asbestos Waste Containers: Containers for dust and waste shall be, dust tight, suitable for the type of waste, impervious to asbestos and any chemicals used during the removal process, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before being removed from the work area, and removed from the workplace frequently and at regular intervals.

2.1.4.1 Waste shall be contained in two separate containers. The inner container shall be a sealable polyethylene bag (or where the glove bag method is used, the glove bag itself). Where there are sharp objects included in the waste material, the outer container shall be a sealable fibre type drum, otherwise the outer container may be a sealable polyethylene bag.

2.1.4.2 Container must be new materials only.

2.1.4.3 Containers shall be as follows:

2.1.4.3.1 Polyethylene Waste Bag: 0.15 mm (6 mil) thick leak-tight polyethylene bags.

2.1.4.3.2 Fibre Drums: 55 US gallon capacity heavy duty leak tight fibre drums with tight sealing locking metal top and metal bottom.

2.1.4.3.3 Labels: Waste containers shall have a pre-printed cautionary asbestos warning label, acceptable to local dump authorities, clearly visible when ready for removal to disposal site.

2.1.5 Caulking: One component non-staining acrylic polymer sealant to conform to GSB Specification 19GP-5M.

2.1.6 Drop Sheets: In polyethylene type and size appropriate for the work being performed.

2.1.7 Electrical Power Cords: Use only grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas of work.

2.1.8 Encapsulant: Type 1 penetrating Class A water based encapsulant conforming to CGSB 1-GP-205M and approved by the Fire Marshall having flame spread and smoke development ratings both less than fifty (50). Acceptable products: Ocean 666, Decadex Fire Check equivalent or better.

2.1.9 Fine Atomizing Spray Nozzle: Nozzle for airless sprayer capable of delivering not less than 1 gallon per minute of fine particle spray of amended water.

2.1.10 Fire Extinguishers: Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

2.1.11 First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry.

2.1.12 Flame-Resistant Polyethylene Sheeting: A single polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films, 0.15 mm (6 mils) thickness.

2.1.13 Foam: Low density polyurethane expanding foam Froth-Pack or equivalent or better.

2.1.14 Garden Sprayer: A hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or fine spray of liquid of amended water under pressure.

2.1.15 Ground Fault Panel: Electrical panel, installed by licensed electrician and equipped as follows:

2.1.15.1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.

2.1.15.2 Interrupters to have a 5 mA ground fault protection.

2.1.15.3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.

2.1.15.4 Openings sealed to prevent moisture or dust penetration.

2.1.16 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. All air must be filtered by HEPA filter before discharge.

2.1.17 Lockdown Sealer: Slow-drying sealer shall be a non-staining, clear, water dispersable type that remains tacky on the surface for a minimum of 8 hours for the purpose of trapping any residual airborne fibres during the settling period. Lock-down agent shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. The product must have flame spread and smoke development ratings both less than 50 and shall leave no stain when dry. Also referred to as “Lockdown Agent”.

2.1.18 Negative Air Unit: Portable air handling system which extracts air directly from the Asbestos Work Area and discharges the air to the exterior of the Asbestos Work Area. Equipped as follows:

2.1.18.1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.

2.1.18.2 Pressure differential gauge to monitor filter loading.

2.1.18.3 Auto shut off and warning system for HEPA filter failure.

2.1.18.4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.

2.1.19 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.

2.1.19.1 Fibre-Reinforced (Rip-Proof) Polyethylene Sheeting: 8 mil (0.20mm) fabric made up from one layer of 5 mil (0.13 mm) weave and two layers of 1.5 mil (0.04 mm)

poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.

2.1.19.2 Flame-Resistant Polyethylene Sheeting: A single polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films, 6 mil (0.15 mm) thickness.

2.1.20 Power Washer: Spray equipment for saturation of asbestos-containing material with amended water for cleaning of surfaces in abatement work area after asbestos removal, capable of delivering an airless stream of water at a pressure of not less than 1200 psi or exceeding 2500 psi.

2.1.21 Protective Coveralls: Disposable full body coveralls complete with hoods manufactured of a material which does not permit penetration of asbestos fibres.

2.1.22 Scaffolding: The type, erection and use of all scaffolding shall comply with all applicable OHSA provisions.

2.1.23 Shower: General shower shall be of the walk through type to permit use by one person at a time.

2.1.23.1 Shower Enclosure: Shower enclosure shall be of a minimum 24 gauge steel walls with baked enamel, galvanized steel, aluminum or stainless steel finish, 16 gauge floor with porcelain enamel finish, brass drain and tapping for mixing valve. Shower installation shall be complete with globe valve for tempered water with a shower head complete with orifice to restrict the flow to 2.5 USGPM.

2.1.23.2 Shower Head and Controls: Provide a factory-made shower head producing a spray of water which can be adjusted for spray size and intensity. Feed shower separately with water from hot and cold supply lines. Arrange so that control of water temperature, flow rate, and shut off is from inside shower without outside aid.

2.1.23.3 Shower Hose Bib: Provide heavy bronze angle type with wheel handle, vacuum breaker, and 3/4" National Standard male hose outlet.

2.1.23.4 Shower Filters: Provide multi-stage cascaded filter units on drain lines from showers or any other water source carrying asbestos-contaminated water from the work area. Provide units with disposable filter elements where the primary filter passes particle 20 microns and smaller and the final filter passes particles 5 microns and smaller. Connect so that discharged water passes primary filter and output of primary filter passes through secondary filter.

2.1.23.5 Shower Pan: Provide one piece waterproof shower pan of minimum size 4' x 8' by 6" deep. Fabricate from seamless fibreglass minimum 1/16" thick reinforced with wood, 18 ga. stainless or galvanized steel with welded seems or, copper or lead with soldered seams.

2.1.24 Spray Cement: Spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

2.1.25 Sump Pump: Provide totally submersible waterproof sump pump with integral float switch and shall have a manual switch. Provide unit sized to pump 2 times the flow capacity of all showers or hoses supplying water to the sump, through

the filters specified herein when they are loaded to the extent that replacement is required. Provide unit capable of pumping debris, sand, plaster or other materials washed off during decontamination procedures without damage to mechanism of pump.

2.1.26 Tape: Reinforced cloth or fibreglass reinforced tape, or vinyl tape, in 2" or 3" widths suitable for sealing polyethylene sheeting under both wet conditions using amended water, and dry conditions.

2.1.27 Temporary Lighting: Provide general service incandescent lamps or fluorescent lamps of wattage required for adequate illumination as required by the work. Protect lamps with guard cages grounded together to distribution panel or tempered glass enclosures.

2.1.28 Water Heater: ULC rated electric water heater appropriately sized for project to supply hot water for the Decontamination Unit shower. Activate from ground fault panel. Provide with relief valve compatible with water heater operation; pipe relief valve down to drip pan on floor with rigid piping. Drip pans shall consist of a 4'x 4' x 6" deep pan, made of 19 gauge galvanized steel, with handles.

2.1.29 Wetting Agent: Non-sudsing surface active agent. Acceptable product Aqua-Gro or approved equal.

3. EXECUTION

3.1 Preparation Prior to Contamination

3.1.1 Establish personal hygiene facilities for workers to wash their hands and face. Washing facilities to include sufficient supplies of disposable hand towels, hand soap, a waste receptacle and a mirror.

3.1.2 Provide to the Asbestos Abatement Consultant an itemized list of pre-existing damage in Work Area.

3.1.3 Move equipment, tools, supplies, stored materials, etc. which can be performed without disturbing ACM, to a location designated by the Owner's Representative.

3.1.4 Install Worker Decontamination Facility. Worker Decontamination Enclosure System shall comprise of Equipment and Access Room, a Shower Room, and a Clean Room, as follows:

3.1.4.1 Equipment and Access Room: build an Equipment and Access Room between Shower Room and work areas, with two air locks, one to the Shower Room and one to work areas. The Equipment and Access Room shall be large enough to accommodate the storage of work boots, or any other protective clothing that might be used again, and at least three workers allowing them sufficient space to undress comfortably.

3.1.4.2 Shower Room: build a Shower Room between the Clean Room and Equipment and Access Room, with two air locks, one to the Clean Room and one to Equipment and Access Room. Provide a constant supply of hot and cold water. The Shower Room shall have individual controls inside the room to regulate water temperature and flow. Provide piping/high pressure hoses and connect to

water sources and drains. Pump waste water through a 5 micrometre filter system acceptable to Consultant before directing into drains. Provide soap, clean towels and appropriate containers for disposal of used respirator filters. One shower shall be established for every 6 workers within the Asbestos Work Area.

3.1.4.3 Clean Room: build a Clean Room between the Shower Room and clean areas outside of enclosures, with two air locks, one to outside of enclosures and one to Shower Room. Provide lockers or hangers for workers street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install a mirror to permit workers to fit respiratory equipment properly, and sufficient hangers and hooks.

3.1.5 Construct three-chamber Decontamination Enclosures as follows:

3.1.5.1 Build suitable framing for enclosures, and line with polyethylene sheeting sealed with tape. Framing shall be constructed of 2" x 4" studs (stud grade) at 24" o/c (max.) with 2" x 4" wood sill and top plates (stud grade) fastened with a minimum of two 3 1/2" common nails per stud end. Use one layer of rip-proof polyethylene on floors. Use 2 layers of opaque rip-proof polyethylene sheeting on walls and ceiling: an inner layer made up of 6 mil poly, and an outer layer made up of rip-proof polyethylene.

3.1.5.2 Build curtained doorways between enclosures.

3.1.6 Erect walls separating Asbestos Work Area from Occupied Areas as follows:

3.1.6.1 Build suitable floor to ceiling lumber stud framing, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood. Seal all joints between plywood sheets and between plywood and adjacent materials with surface film forming type sealer, to create an airtight barrier.

3.1.6.2 Cover plywood barrier with polyethylene sealed with tape, as specified for work areas.

3.1.6.3 Caulk as required, edges of partition both sides at floor, walls and around fixtures.

3.1.7 Supply water as required for Asbestos Work Area and Decontamination Facilities. Water to be supplied from an existing potable water system. Contractor is responsible for all fittings. Contractor shall install using vacuum breakers or other backflow preventer as required by local authority.

3.1.7.1 Water supply shall be by means of copper pipe, or high pressure hoses, and fittings on high-pressure hose and fittings. A master shut-off valve shall be installed adjacent to, and on the clean side, of the decontamination facility. Any hose and hose connections must be for high pressure only and downstream of the master shut-off valve and is not to be left under pressure unattended. Maintain hose connections and outlet valves in leak proof condition. Where finish work below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize the possibility of water damage. Drain water promptly from pans as it accumulates.

3.1.8 Provide and install drainage facilities from temporary shower.

3.1.9 Provide and install drainage in removal work areas as required.

3.1.10 Provide and install a filtration system to filter all water to be disposed of from the removal and decontamination area.

3.1.11 Pre-clean all surfaces in the Asbestos Work Area. Visible dust shall be removed with a damp cloth/mop or a vacuum equipped with a HEPA filter from any surface in the work area, including the thing to be worked on, if the dust on that surface is likely to be disturbed.

3.1.12 Disable fire alarms, heat detectors, and smoke detectors in the Asbestos Work Area. At no time are the above systems to be affected in areas outside the Asbestos Work Area. Coordinate with, and notify Owner. Notify emergency services.

3.1.12.1 Provide Fire Watch services for any areas where life safety devices are deactivated and may be vacant for any period of time.

3.1.13 Erect sealed worker platforms, where necessary, as follows:

3.1.13.1 Shop drawings of all platform layouts, hoarding and details to be submitted to Asbestos Abatement Consultant prior to commencing work.

3.1.13.2 Scaffolding and platforms, if required, shall be designed by a professional engineer and built in accordance to the design.

3.1.13.3 Install support bases of sufficient dimension and strength to protect floors. Repair or replace damage caused by erection, weight or dismantling of platform.

3.1.13.4 Install platform supports in and around existing fixtures, walls, doors and equipment so as not to interfere with the operating, use, or maintenance of space or equipment. Leave 36" (900 mm) clear around all operating equipment.

3.1.13.5 Install platform to maintain a minimum clear height of 7’-0” (2135 mm).

3.1.13.6 Construct a framework of metal scaffolding or equivalent on top of which the working platform is to be placed. The working platform shall consist of one layer of rip-proof polyethylene below scaffold boards over which plywood (of sufficient thickness to support personnel and equipment as required by Occupational Health and Safety Act and Regulations) is nailed in place.

3.1.13.7 Caulk and tape plywood seams to provide a barrier to water penetration.

3.1.13.8 Seal platform to prevent any water leakage during removal by covering working platform with moisture impermeable barrier consisting of at least two layers of rip-proof polyethylene.

3.1.13.9 Install Hoarding Walls so as to completely isolate platform from Occupied Area.

3.1.13.10 Install fluorescent lighting at underside of platforms to maintain existing lighting levels.

3.1.13.11 Provide 1 emergency escape hatch for each 500 square feet (50 square meters) of platform. The hatch is to be constructed in a water and air tight manner that can be readily opened in an emergency situation. Provide emergency lighting at each hatch.

3.1.14 Erect tunnels, where necessary, as follows:

3.1.14.1 Minimum interior clear width of tunnel to be 3’-7” (1100 mm).

3.1.14.2 Install Hoarding walls at both sides of the tunnel so as to isolate the tunnel from the asbestos work area.

3.1.14.3 Maintain a minimum clear height of 7’-0” (2135 mm) to the underside of the tunnel roof.

3.1.14.4 Install 2" x 6" (50 mm x 150 mm) wood or metal roof joists at 16" (400 mm) o/c. with continuous 2" x 6" (50 mm x 150 mm) headers.

3.1.14.5 Cover roof joists with 3/4" (20 mm) plywood sheeting.

3.1.14.6 Caulk and tape joints in plywood, and cover with two layers of rip-proof polyethylene. One layer to extend continuously over rip-proof polyethylene on the perimeter walls.

3.1.14.7 Install one layer of good one side plywood at underside of joist.

3.1.14.8 Install fluorescent lighting at underside of tunnel to maintain existing lighting levels.

3.1.15 Erect equipment enclosures where specified as per Mechanical or Electrical drawings.

3.1.16 Carefully protect items scheduled to remain in place using polyethylene, spray adhesive, tape, caulking, etc.

3.1.17 Seal all below deck openings, and openings at deck level, to Asbestos Work Area using polyethylene, spray adhesive, tape, caulking, etc., including but not limited to windows, doors, vents, diffusers, etc.

3.1.18 Seal all openings in floor using plugs, tape, caulking, rip-proof polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene. Include floors of duct and service shafts.

3.1.19 For operations requiring the use of a power tool on a non-friable product, where the work area is not enclosed by walls, and where the enclosure is prepared with opaque materials (i.e. orange rip-proof polyethylene), the enclosure shall include one or more transparent (clear) window areas to allow observation of the entire work area from outside the enclosure.

3.1.20 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Fire Commissioner of Canada and Provincial Fire Marshall.

3.1.21 Provide a fire extinguisher at each emergency exit and in both sides of the decontamination facilities.

3.1.22 Install temporary lighting in all work areas at levels that will provide for a safe and efficient use of the work area. Install battery powered emergency lights so as to light exit routes through Asbestos Work Area.

3.1.23 Protect floors as follows, as applicable,

3.1.23.1 If plaster ceilings or other items are being demolished that may damage finishes, protect surfaces with plywood.

3.1.23.2 Sprayed fireproofing removal, install 2 layers of 6-mil rip proof polyethylene.

3.1.23.3 Floor on grade and/or concrete, install 1 layer of 6-mil rip proof polyethylene.

3.1.23.4 For all areas, extend floor protection a minimum of 12" up all vertical surfaces in the Asbestos Work Area. Each layer of polyethylene is to be laid and sealed independently of each other.

3.1.24 Install 2 layers of polyethylene on all walls forming the perimeter of the Asbestos Work Area. Each layer of polyethylene is to be laid and sealed independently of each other. Overlap wall polyethylene with floor polyethylene by a minimum of 12” (305 mm) at each layer.

3.1.25 In areas where walls do not enclose the Asbestos Work Area, erect polyethylene hoarding walls between Occupied Area and Work Area to create the Asbestos Work Area Enclosure. Construct a frame for the enclosure from 50 mm x 100 mm (2” x 4”) construction grade wood studs and polyethylene. If the potential exists for the disturbance of ACM during the construction of the enclosure, wear a respirator and suitable protective clothing; ensure that the enclosure is of adequate size to permit the storage of equipment and waste.

3.1.25.1 Support polyethylene sheeting enclosures as required or as directed by Asbestos Abatement Consultant.

3.1.25.2 Enclosure may be supported from the deck system(s), if applicable.

3.1.26 Provide a sealed polyethylene top for free standing enclosures. Overlap perimeter polyethylene to form flap doorway.

3.1.27 Establish negative pressure in Asbestos Work Areas as follows:

3.1.27.1 Distribute negative air filter/fan units evenly around the Asbestos Work Area. Remove windows, if required, and replace with 1/2" plywood with appropriately sized openings for exhaust. Switch the negative air pressure system to the "ON" mode and operate continuously until final completion of the work, including final cleanup. Exhaust air to the outside of the Work Area. A spare negative air unit will be fully installed and ready to operate as a backup unit. The negative air pressure system must have the capacity to exchange air volume of the work area four times per hour and maintain a minimum of 0.02 inches of water gauge differential. Operate negative pressure system continuously from the time the first polyethylene is installed to seal openings until final completion of the work including final cleanup and air testing. Replace pre-filters and HEPA filters as required and on a regular basis to maintain even and constant draw across negative air unit. Do not discharge negative air ducting with-in 25 feet of building access points. Replace windows removed for discharge panels upon completion of project, if window removal was required.

3.1.27.2 Provide sufficient negative air pressure to exchange a volume of air equivalent to that of the Asbestos Work Area a minimum of every 15 minutes.

3.1.27.3 Leak test negative air units in place using DOP/PAO method prior to each Type 3 or Level III operation.

3.1.27.4 Do not discharge negative air units into Occupied Areas unless specified or with written approval from Asbestos Abatement Consultant.

3.1.28 Isolate at panel and disconnect or ground existing power supply to Asbestos Work Area where necessary. Power supply to remaining areas of building must not be disrupted during work of this section.

3.1.29 Post signs at locations where access to a sealed Asbestos Work Area is possible. Signs shall be installed at Curtained Doorways leading directly into a contaminated area. Such signs shall read:

CAUTION

Asbestos Hazard Area
No Unauthorized Entry
Wear assigned protective equipment
Breathing asbestos dust may cause serious bodily harm

3.1.30 Do not proceed with work of Contaminated Preparation without obtaining written permission from the Asbestos Abatement Consultant. Provide a minimum of 24 hours notice to consultant for the need of an inspection.

3.2 Contaminated Preparation

3.2.1 Use full personal protective procedures and equipment, amended water and HEPA vacuums during contaminated preparation.

3.2.2 Disable air-handling system affecting Asbestos Work Area. Seal ventilation ducts to and from the work area. The air handling system shall not be enabled until completion of work.

3.2.3 Shut off and lock out electrical power within the enclosure. Refer to electrical specifications.

3.2.4 Remove and dispose of ceilings and other obstructions to access ducts supplying into and exhausting from the Asbestos Work Area, or ducts to remain live within the Asbestos Work Area.

3.2.5 Where applicable, seal ducts supplying into and exhausting from the Asbestos Work Area during one shift, as follows:

3.2.5.1 Cut and cap ducts as close as possible to perimeter of Asbestos Work Area.

3.2.5.2 Cap with metal of gauge equal to sheet metal being capped.

3.2.5.3 Seal seams of cap with duct sealant, tape and polyethylene sheeting.

3.3 Work above Ceilings

3.3.1 Remove and dispose of ceilings and other obstructions around perimeter to access upper perimeter of the Asbestos Work Area.

3.3.2 Remove ceilings in sections equal to the work that can be performed in one shift.

3.3.3 Seal holes in existing perimeter walls, columns, deck, etc. exposed by removal of ceiling at upper perimeter of Asbestos Work Area.

3.3.4 Cover Asbestos Work Area upper perimeter walls with 2 layers of 6-mill rip proof, independently sealed, polyethylene.

3.3.5 Remove and replace remaining ceiling tiles with grid and support systems.

3.3.6 Temporarily support and protect with polyethylene, existing items to remain that were previously supported by the ceiling systems.

3.3.7 Protect electrical systems to remain in the Asbestos Work Area with polyethylene and tape, including but not limited to communication systems, coaxial, triaxial, fire and public address systems, wiring, conduit, speakers, heat and smoke detectors, alarms, lights, equipment, junction boxes, speakers, thermostats, light fixtures, etc.

3.3.7.1 Refer to electrical specifications for additional direction.

3.3.8 Do not proceed with work of Ceiling Removal without obtaining written permission from the Asbestos Abatement Consultant. Provide a minimum of 24 hours notice to consultant for the need of an inspection.

3.4 Asbestos Removal

3.4.1 Spray asbestos material with water containing the specified wetting agent, using airless spray equipment capable of providing a "mist" application to prevent release of fibres. Saturate the asbestos material sufficiently to wet it to the substrate without causing excess dripping. Spray the asbestos material repeatedly during work process to maintain saturation and to minimize asbestos fibre dispersion. Score the outer surface where water does not penetrate the outer layers.

3.4.2 Remove the saturated asbestos material in small sections. Do not allow saturated asbestos to dry out. As it is being removed, pack the material in sealable plastic bags 0.15 mm minimum thick and place in labelled containers for transport. Collect waste water from the floor, do not allow it to pool. Mist the air continuously where asbestos is being disturbed with amended water using one dedicated airless sprayer equipped with a fine atomizing nozzle. If fibre levels exceed 2.0 f/cc, then additional dedicated sprayer(s) will be required as directed by the Asbestos Abatement Consultant. Contain waste water in sealable plastic containers, suitable for transport and disposal without leaking or dispose of by pumping into a settling tank, filtering the water using specified filters, and then pumping into a sanitary sewer.

3.4.3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination washroom. Wash containers thoroughly in decontamination washroom, and store in holding room pending removal to unloading room and outside. Ensure that containers are removed from the holding room by workers who have entered from uncontaminated areas dressed in clean coveralls.

3.4.4 After completion of removal work, all surfaces from which asbestos has been removed shall be wire brushed and wet-sponged to remove all visible material. During this work the surfaces shall be kept wet.

3.4.5 Where Asbestos Abatement Consultant decides complete removal of asbestos-containing material is impossible due to obstructions such as structural members

or major service elements, and provides written direction, seal the material as directed by the Consultant.

3.4.6 After wire brushing and wet sponging to remove visible asbestos, wet clean the entire work area including the Equipment and Access Room, and equipment used in the process.

3.4.7 All tools, equipment, materials and supplies that will NOT be reused shall be placed in an asbestos waste container as soon as practicable following completion of the preceeding Items of this Section.

3.4.8 All tools, equipment, materials and supplies that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp wiping, as soon as practicable following completion of the preceding Items of this Section.

3.4.9 Compressed air shall not be used to clean up and remove debris or dust from any surface.

3.4.10 Eating, drinking, chewing or smoking shall not be permitted in the work area.

3.4.11 Maintain all work areas in a neat and orderly fashion at all times.

3.4.12 Pre-filters on fan units shall be treated as asbestos waste and disposed of accordingly.

3.4.13 Do not proceed with work of applying Lock Down Agent without obtaining written permission from the Asbestos Abatement Consultant indicating a visual clearance inspection has been performed and the site is satisfactory to the Consultant. Provide a minimum of 24 hours notice to consultant for the need of a visual clearance inspection.

3.5 Application of Lock Down Agent

3.5.1 After completion of the final cleaning and after the Asbestos Abatement Consultant has passed a visual cleanliness inspection, spray sealant (approved by the Asbestos Abatement Consultant) on all surfaces in the Asbestos Work Area.

3.5.2 Allow an 8 hour settling period, or a time period accepted by the Asbestos Abatement Consultant, for the sealer to dry. During this settling period, no entry or activity will be permitted in the work area.

3.5.3 Obtain written permission from Asbestos Abatement Consultant to proceed with Asbestos Work Area Tear Down and Dismantling following acceptable clearance air monitoring results of 0.01 f/mL. Should clearance air monitoring results exceed 0.01 f.mL, the contractor will, at no cost to the owner, reclean the entire Asbestos Work Area and apply another coat of Lock Down Agent.

3.6 Asbestos Work Area Teardown And Dismantling

3.6.1 Maintain the perimeter seal and Type 3 procedures and use worker decontamination facility.

3.6.2 Operate negative air units during teardown.

3.6.3 Remove all polyethylene, tape, polyurethane foam, caulking and enclosures from Asbestos Work Area.

3.6.4 Remove asbestos contaminated floor polyethylene by carefully rolling away from walls to centre of Asbestos Work Area.

3.6.5 For areas that will require application of new sprayed fire proofing, remove top layer of polyethylene sheeting from surfaces protected by two layers of polyethylene sheeting. The inner layer of polyethylene will remain until all re-fireproofing is complete.

3.6.6 Cut the lower layer of polyethylene sheeting to expose the baseboards, window sills, cabinets, shelves and other horizontal surfaces that may be contaminated by fallen ACM.

3.6.7 Carefully roll polyethylene toward the centre of enclosure. Remove visible debris by means of HEPA vacuum as polyethylene is rolled away.

3.6.8 After the work is completed, polyethylene sheeting and similar materials used for barriers and enclosures shall not be reused, but shall be wetted and placed in an asbestos waste container as soon as practicable following completion of the preceeding Items of this Section.

3.6.9 Barriers and portable enclosures shall not be reused unless they are rigid and can be cleaned thoroughly.

3.6.10 Place Polyethylene, tape, cleaning material, clothing and other contaminated waste in asbestos waste containers and dispose of as asbestos waste.

3.6.11 Seal vacuum hoses and fittings, flexible ductwork and all tools used in contaminated work site in 6 mil polyethylene bags prior to removal from Work Area.

3.6.12 Wash equipment used in contaminated Asbestos Work Area to remove all asbestos contamination, or double bag for transportation prior to being removed from Asbestos Work Area, via waste and equipment decontamination facility.

3.6.13 Clean up Asbestos Work Area, Equipment and Access area, washing/Showering Room, and other enclosures that may be contaminated.

3.6.14 Remove polyethylene protection and hoarding walls where hoarding walls separate occupied areas from work area.

3.6.15 Hoarding walls to remain are identified on drawings, if applicable.

3.6.16 Remove polyethylene sheeting from contaminated side of decontamination facilities.

3.6.17 Wash and mop with clean water all surfaces in the Asbestos Work Area.

3.6.18 Remove all temporary lights, ground fault panels and Negative Pressure Units.

3.6.19 Remove negative air unit prefilters. Dispose of as asbestos contaminated waste.

3.6.20 Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape.

3.6.21 Maintain all hoarding walls adjacent to areas where ACM is present and in good condition.

3.6.22 Remove decontamination facilities, platforms and platform scaffolding, tunnels, etc.

3.6.23 Damp mop and clean with HEPA vacuum Occupied Areas previously below platforms, tunnels and decontamination facilities with HEPA vacuum.

3.7 Re-establishment of Objects and Systems

3.7.1 Make good at completion of work, all damage not identified in pre-removal survey.

3.7.2 Reinstall objects and items removed to facilitate removal of ACM.

End of Section

LIST OF CONTENTS

Page

1. GENERAL 2

1.1 General and Related Work 2
1.2 Definitions 2
1.3 Worker Protection 6
1.4 Visitor Protection 8
1.5 Air Monitoring 8
1.6 Waste Transport And Disposal 9

2. PRODUCTS 9

2.1 Materials and Equipment 9

3. EXECUTION 13

3.1 General Measures and Procedures 13
3.2 Measures and Procedures for Type/Class 1 Operations 14
3.3 Measures and Procedures for Type/Class 2 A/B Operations 14
3.4 Measures and Procedures for Type/Class 3 A/B Operations 16
3.5 Measures and Procedures for Cleaning of Lead Dust 19
3.6 Preparation Prior to Contamination 20
3.7 Contaminated Preparation 21
3.8 Lead-Abatement Work Area Dismantling 22

1. GENERAL

1.1 General and Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere

Division 02	Section 02 82 00	Abatement Scope and Details
Division 02	Section 02 82 01	Type 1 Asbestos Abatement
Division 02	Section 02 82 02	Type 2 Asbestos Abatement
Division 02	Section 02 82 04	Type 3 Asbestos Abatement
Division 02	Section 02 83 10	Other Hazardous Materials
Division 02	Section 02 84 00	PCB Capacitors and Ballasts

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 The Abatement Contractor is responsible to verify all measurements for removal, cleaning, and re-insulation purposes. Measurements and quantities provided herein are for reference only.

1.1.4 It is the intent that lead abatement performed as per this section will result in the removal and disposal of lead paint and lead-containing materials, as necessary, as well as any materials that may have been contaminated by lead dust either during or prior to work of this Section.

1.1.5 Refer to Section 02 82 00, Abatement Scope and Details, for the following information and requirements;

1.1.5.1 Site Conditions,

1.1.5.2 Outline of Work,

1.1.5.3 Schedule,

1.1.5.4 Supervision,

1.1.5.5 Quality Assurance,

1.1.5.6 Regulations,

1.1.5.7 Notification, and

1.1.5.8 Submittals.

1.2 Definitions

1.2.1 Airlock: A system for permitting ingress or egress without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways at least 1.5 m apart.

1.2.2 Air Monitoring: The process of measuring the lead-contaminated dust content of a specific volume of air.

1.2.3 Amended Water: Water with a non-ionic surfactant wetting agent added to reduce water surface tension to 35 or less dynes, to allow thorough wetting of settled dust.

1.2.4 Lead-Abatement Work Area: Where the actual removal of lead-containing or lead-contaminated materials takes place.

1.2.5 Authorized Visitor: The Owner or his approved representative and/or persons representing regulatory agencies.

1.2.6 Barrier: Any surface that seals off the Lead-Abatement Work Area to inhibit the movement of dust.

1.2.7 Clean Area: Either an operating area or an area in which removal work has already been completed.

1.2.8 Competent Personnel: a worker who is qualified because of knowledge, training and experience to perform the work; is familiar with the Ontario Occupational Health and Safety Act and with the provisions of the regulations that apply to the work, and; has knowledge of all potential or actual danger to health or safety in the work.

1.2.9 Curtained Doorway: An arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed by placing two overlapping sheets of polyethylene over an existing or temporarily framed doorway, securing each along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. All free edges of polyethylene shall be reinforced with duct tape and the bottom edge shall be weighted to ensure proper closing. Each polyethylene sheet shall overlap openings not less than 1.5 m on each side.

1.2.10 Demolition: The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.

1.2.11 Disposal Bag: A properly labelled 6 mil thick leak-tight plastic bag used for transporting lead waste from the Lead-Abatement Work Area to the disposal site.

1.2.12 DOP / PAO Test: Dioctylphthalate / Poly Alpha Olefin aerosol challenge of a HEPA filter system and is used to establish the integrity and effectiveness of the system to filter out lead particles and dust.

1.2.13 Enclosure: 6 mil polyethylene sheeting installed to fully isolate Lead-Abatement Work Area. Enclosure may be a prefabricated self-supporting structure or constructed with a rigid frame, or, when applicable, supported by the ceiling grid. Enclosure shall have polyethylene sheeting as a top at locations where the enclosure does not extend up to the underside of the ceiling or underside of structure.

1.2.14 Filter: A media component used in respirators, vacuum cleaners or negative pressure filter fan units to remove solid or liquid particles from the inspired air.

1.2.15 Fitting: Unless otherwise described in Site Conditions, all connections of a pipe which include elbows, ends, caps, valves, hangers, tees and unions, etc.

1.2.16 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.

1.2.17 Negative Pressure: A system which extracts air directly from the Lead-Abatement Work Area, filters such extracted air through a High Efficiency Particulate Air filtering system, and discharges this air directly outside Lead-Abatement Work Area to exterior of building. This system shall maintain a minimum pressure differential of 0.02 inches Water Gauge relative to adjacent areas outside of Lead-Abatement Work Areas, be equipped with an alarm to warn of system breakdown (i.e., excessive negative pressure or insufficient negative pressure), and be equipped with an instrument to continuously monitor and automatically record pressure differences.

1.2.18 Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

1.2.19 Occupied Area: Any area of the building outside the Lead-Abatement Work Area.

1.2.20 Polyethylene: Sheeting of type and thickness specified sealed with tape along all edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealant, and to prevent escape of lead particulate through the sheeting into a clean area.

1.2.21 Positive Pressure Respirator: A respirator in which the air pressure inside the respiratory inlet covering is positive during inhalation and exhalation in relation to the air pressure of the outside atmosphere.

1.2.22 Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

1.2.23 Straight run pipes: Part of the building system not included under the description of Fitting, including but not limited to straight, angled or curved sections of pipe, pumps, headers and reducers.

1.2.24 Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

1.2.25 Type/Class 1 Lead Operations: Defined by the Ministry of Labour document *Guideline - Lead on Construction Projects*, dated April 2011, and the Environmental Abatement Council of Canada (EACC) document; *Lead Guideline for Construction, Renovation, Maintenance or Repair*, dated October 2014, includes the following operations:

1.2.25.1 Removal of lead-containing or lead-based paints and surface coatings with a chemical gel/stripper or paste.

1.2.25.2 Application of lead-containing or lead-based paints and surface coatings with a brush, roller or sponge.

1.2.25.3 Installation or removal of lead sheeting or flashing.

1.2.25.4 Installation or removal of lead-containing packing, babbitt, caulking, gasket or similar material.

1.2.25.5 Removal of materials coated with lead-containing or lead-based paints and surface coatings, using non-powered hand tools, where the material remains chiefly intact and is not crumbled, pulverized or powdered.

1.2.25.6 Operating construction or demolition equipment (e.g. excavator, bulldozer) during building renovation or demolition where lead-based paints or surface coatings are present on building materials and are being disturbed.

1.2.25.7 Soldering with lead solder.

1.2.25.8 Removing lead-containing or lead-based paints or surface coatings with a heat gun.

1.2.25.9 Removing lead-containing and lead-based paints and surface coatings using a high-pressure water jet (e.g. pressure washer)

1.2.26 Type/Class 2A Lead Operations: Defined by the Ministry of Labour document *Guideline - Lead on Construction Projects*, dated April 2011, and the Environmental Abatement Council of Canada (EACC) document; *Lead Guideline for Construction, Renovation, Maintenance or Repair*, dated October 2014, includes the following operations:

1.2.26.1 Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool that has an effective dust collection system equipped with a HEPA filter.

1.2.26.2 Welding, torching or high temperature cutting of lead-containing materials indoors when using an effective fume collector or smoke eater that filters and exhausts lead fume and expels it directly outdoors (away from occupants, entrances, walkways, rest areas, etc.). Fume collector or smoke eater must have effective source control and capture velocity, minimum of 0.5 metres per second (100 feet per minute) at the work surface.

1.2.26.3 Welding, torching or high temperature cutting of lead-containing and lead-based paints and surface coatings or lead-containing materials outdoors.

1.2.26.4 Removal of lead-containing mortar using handheld non-powered tools.

1.2.26.5 Removal of lead-containing and lead-based paints and surface coatings or lead-containing materials by scraping or sanding (including wet sanding) using non-powered hand tools.

1.2.26.6 Clean up and removal of a significant amount of lead-containing dust and debris (that can be made easily airborne) using wet methods or HEPA vacuums.

1.2.27 Type/Class 2B Lead Operations: Defined by the Ministry of Labour document *Guideline - Lead on Construction Projects*, dated April 2011, and the Environmental Abatement Council of Canada (EACC) document; *Lead Guideline for Construction, Renovation, Maintenance or Repair*, dated October 2014, includes the following operations:

1.2.27.1 Spray application of lead-containing paints and surface coatings.

1.2.28 Type/Class 3A Lead Operations: Defined by Ministry of Labour document *Guideline - Lead on Construction Projects*, dated April 2011, and the Environmental Abatement Council of Canada (EACC) document; *Lead Guideline for Construction, Renovation, Maintenance or Repair*, dated October 2014, includes the following operations:

1.2.28.1 Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool without an effective dust collection system equipped with a HEPA filter.

1.2.28.2 Welding, torching or high temperature cutting of lead-containing materials indoors or in a confined space (e.g. within a ditch or pit).

1.2.28.3 Removal of lead-containing mortar using a powered cutting device.

1.2.28.4 Burning of a material containing lead.

1.2.28.5 Removal, cleaning or repair of a ventilation system or ductwork used for controlling lead exposure

1.2.28.6 Spray application of lead-based paints and surface coatings.

1.2.28.7 In the absence of an exposure assessment;

1.2.28.7.1 demolition or cleanup of a facility where lead-containing products were manufactured and significant dust and debris, which can be made easily airborne, is present.

1.2.28.7.2 cleanup of dust and debris down range of a firing station in an indoor firing range.

1.2.28.7.3 an operation that may expose a worker to lead dust, fume or mist that is not a Class 1, Class 2, or Class 3B operation.

1.2.29 Type/Class 3B Lead Operations: Defined by Ministry of Labour document *Guideline - Lead on Construction Projects*, dated April 2011, and the Environmental Abatement Council of Canada (EACC) document; *Lead Guideline for Construction, Renovation, Maintenance or Repair*, dated October 2014, includes the following operations:

1.2.29.1 Abrasive blasting of lead-containing and lead-based paints and surface coatings or lead-containing materials (including wet, slurry and dry abrasive blasting and dry-ice blasting).

1.2.30 Water Filtration System: A multi-stage filtration system for filtering shower and wastewater. Typically constructed with at least two filters, the primary stage retains 20 microns or larger particles and the final stage removes 5 micron or larger particles.

1.2.31 Work: Includes all services, labour and material required to complete the work as specified in the contract.

1.2.32 Work Area(s): Area(s) where work takes place that will, or may disturb lead-containing materials.

1.3 Worker Protection

1.3.1 Prior to commencing work, the Abatement Contractor shall instruct workers in all aspects of work procedures and protective measures.

1.3.2 The Abatement Contractor shall, provide workers with personally issued marked respiratory equipment acceptable to the Occupational Health and Safety Division of the Ontario Ministry of Labour, suitable for the expected lead dust exposure.

1.3.3 Ensure that suitable respiratory protective equipment is worn by every worker who enters the Asbestos Work Area. A respirator provided by an employer and used by a worker shall be:

1.3.3.1 One of the following types depending on the classification of work and method removal;

1.3.3.1.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filters;

1.3.3.1.2 Air purifying full-facepiece respirator with N-100, R-100 or P-100 particulate filters;

1.3.3.1.3 Powered air purifying respirator equipped with a tight-fitting facepiece (half or full-facepiece) and a high efficiency filter or N-100, R-100 or P-100 particulate filters;

1.3.3.1.4 Negative pressure (demand) supplied air respirator equipped with a full-facepiece;

1.3.3.1.5 Continuous flow supplied air respirator equipped with a tight fitting facepiece (half or full-facepiece);

1.3.3.1.6 Pressure demand supplied air respirator equipped with a half or full-facepiece mask.

1.3.3.2 Fitted so that there is an effective seal between the respirator and the worker's face;

1.3.3.3 Assigned to a worker for the worker's exclusive use, if practical;

1.3.3.4 Used and maintained in accordance with the procedures specified by the equipment manufacturer;

1.3.3.5 Cleaned, disinfected and inspected after use on each shift, or more often if necessary;

1.3.3.6 Free of damaged or deteriorated parts replaced prior to being used by a worker;

1.3.3.7 Be stored in a convenient, clean and sanitary location; when not in use;

1.3.3.8 Certified by the US National Institute for Occupational Safety and Health (NIOSH) for exposure to airborne particulates.

1.3.4 The Abatement Contractor shall establish written procedures regarding the selection, use and care of respirators.

1.3.5 A copy of the procedures shall be provided to and reviewed with each worker by the Abatement Contractor.

1.3.6 A worker shall not be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

1.3.7 The Abatement Contractor shall provide all workers with full body disposable coveralls.

1.3.8 The Abatement Contractor shall ensure that full body disposable coveralls are worn by every worker who enters the Lead-Abatement Work Area. The protective clothing provided by an employer and used by a worker shall:

1.3.8.1 Be made of a material which does not readily retain nor permit penetration of lead particulate;

1.3.8.2 Consist of head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent lead particulate from reaching the garments and skin under the protective clothing;

1.3.8.3 Include suitable footwear;

1.3.8.4 Be repaired or replaced if torn.

1.3.8.5 Provide other body protection required under applicable safety regulations.

1.3.9 The Abatement Contractor shall ensure that personnel are fully protected at all times when possibility of exposure to lead dust exists.

1.3.10 The Abatement Contractor shall provide and post in Clean Change Room the procedures described under Worker Protection.

1.3.10.1 No person shall eat, drink, smoke or chew except in established locations outside the Lead-Abatement Work Area.

1.3.10.2 Personnel shall be fully protected at all times when possibility of disturbance of lead dust exists.

1.4 Visitor Protection

1.4.1 The Abatement Contractor shall provide clean protective clothing and equipment and approved respirators to Authorized Visitors.

1.4.2 The Abatement Contractor shall ensure that Authorized Visitors have received required training for entry into Lead-Abatement Work Area.

1.5 Air Monitoring

1.5.1 Air monitoring may be performed by the Environmental Consultant at all stages of the abatement.

1.5.2 The Abatement Contractor shall cooperate fully with the Environmental Consultant in the collection of air monitoring samples, including the collection of personal worker samples, if required.

1.5.3 The occupational exposure limit for lead is 0.05 mg/m^3, required by the MOL, under O. Reg. 490/09, as amended. Results of air samples of 0.025 mg/m^3, or greater, outside of Abatement Work Area, will be deemed as the action level, at which will require a modification of abatement procedures to reduce airborne lead dust concentrations. Results of air samples of 0.05 mg/m^3 or greater, outside of Lead-Abatement Work Area, will indicate lead dust contamination of

these areas. The contaminated areas shall be isolated and cleaned in the manner applicable for the clean-up of lead-contaminated dust by the Abatement Contractor, at no cost to the Owner.

1.5.4 Clearance air monitoring samples shall be collected by the Environmental Consultant after a suitable settling period following application of lock-down agent. Clearance levels must be less than 0.05 mg/m^3 for the Lead-Abatement Work Area to be deemed clean.

1.6 Waste Transport And Disposal

1.6.1 The Abatement Contractor shall ensure lead-contaminated materials, removed during abatement are treated, packaged, transported and disposed of as lead waste.

1.6.2 The Abatement Contractor shall drop garbage bins at designated locations. Keep bins covered and enclosed while at the site. Bin loading area shall be kept clean at all times.

1.6.3 The Abatement Contractor shall pick-up and drop off garbage bins at pre-approved times, and shall not interfere with the Owners operations.

1.6.4 The Abatement Contractor shall conform to requirements of Regulations under Environmental Protection Act for Waste Management, transporting and disposal of hazardous waste.

1.6.5 The Abatement Contractor shall ensure shipment of containers to dump is taken by a waste hauler licensed to transport lead waste.

1.6.6 The Abatement Contractor shall ensure that a bill of lading, showing the type and weight of hazardous waste being transported, is completed for each load.

1.6.7 The Abatement Contractor shall check with dump operator to determine type of waste containers acceptable.

1.6.8 The Abatement Contractor shall ensure dump operator is fully aware of hazardous material being dumped.

1.6.9 The Abatement Contractor shall co-operate with Ministry of the Environment and Climate Change inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to Owner.

2. PRODUCTS

2.1 Materials and Equipment

2.1.1 The Abatement Contractor shall ensure that all tools, equipment, materials and supplies brought to work site are in good condition and free of lead, lead debris, and lead-contaminated materials.

2.1.2 The Abatement Contractor shall ensure that disposable tools, equipment, materials and supplies are of new materials only.

2.1.3 Airless Sprayer: Spray equipment for water: for application to lead dust contaminated materials. Airless spray units are only acceptable, such as Grace Hydrospray or approved equal.

2.1.4 Caulking: One component non-staining acrylic polymer sealant to conform to GSB Specification 19GP-5M.

2.1.5 Drop Sheets: In polyethylene type and size appropriate for the work being performed.

2.1.6 Electrical Power Cords: Use only grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas of work.

2.1.7 Flame-Resistant Polyethylene Sheeting: A single polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films, 0.15 mm (6 mils) thickness.

2.1.8 Fine Atomizing Spray Nozzle: Nozzle for airless sprayer capable of delivering not less than 1 gallon per minute of fine particle spray of water.

2.1.9 First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry.

2.1.10 Fire Extinguishers: Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

2.1.11 Foam: Low density polyurethane expanding foam Froth-Pack or equivalent or better.

2.1.12 Garden Sprayer: A hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or fine spray of liquid of water under pressure.

2.1.13 Ground Fault Panel (All sections require approval from the Owner): Electrical panel, installed by licensed electrician and equipped as follows:

2.1.13.1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Lead-Abatement Work Area.

2.1.13.2 Interrupters to have a 5 mA ground fault protection.

2.1.13.3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.

2.1.13.4 Openings shall be sealed by the Abatement Contractor to prevent moisture or dust penetration.

2.1.14 HEPA Vacuum: Vacuum with necessary fittings, tools and attachments. Discharged air must pass through a HEPA filter.

2.1.15 Lead Dust Waste Containers: The Abatement Contractor shall ensure that waste is contained in two separate containers that are dust-tight and impervious to lead dust and any chemicals used during the removal process. The inner container shall be a sealable polyethylene bag. Where there are sharp objects included in the waste material, the outer container shall be a sealable fibre type drum, otherwise the outer container may either be a sealable polyethylene bag. Containers shall be as follows:

2.1.15.1 Lock-down Agent: Sealant for purpose of trapping residual dust. Product shall have flame spread and smoke development ratings both less than 50. Product shall leave no stain when dry. Lock-down agent shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate.

2.1.15.2 Polyethylene Waste Bag: 0.15 mm (6 mil) thick leak-tight polyethylene bags labelled as required by sub-section 3.5 Waste Disposal.

2.1.15.3 Fibre Drums: 55 US gallon capacity heavy duty leak tight fibre drums with tight sealing locking metal top and metal bottom.

2.1.15.4 Labels: Waste containers shall have a pre-printed cautionary lead dust warning label, acceptable to local dump authorities, clearly visible when ready for removal to disposal site.

2.1.16 Negative Air Unit: Portable air handling system that extracts air directly from the Lead-Abatement Work Area and discharges the air to the exterior of the Lead-Abatement Work Area. Equipped as follows:

2.1.16.1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.

2.1.16.2 Pressure differential gauge to monitor filter loading.

2.1.16.3 Auto shut off and warning system for HEPA filter failure.

2.1.16.4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.

2.1.17 Polyethylene Sheeting: A single polyethylene film, 0.15 mm (6 mil) minimum thickness unless otherwise specified.

2.1.18 Power Washer: Spray equipment for saturation of lead dust contaminated material with water for cleaning of surfaces in Lead-Abatement Work Area after lead dust removal, capable of delivering an airless stream of water at a pressure of not less than 1200 psi or exceeding 2500 psi.

2.1.19 Protective Coveralls: Disposable full body coveralls complete with hoods manufactured of a material that does not permit penetration of lead particulates.

2.1.20 Rip Proof Polyethylene Sheeting: Woven fibre reinforced fabric bonded both sides with polyethylene sheeting. 0.20 mm (8 mil) fabric made up from 0.13 mm (5 mil) weave and 2 layers 0.04 mm (1.5 mil) poly laminate.

2.1.21 Scaffolding: The type, erection and use of all scaffolding shall comply with all applicable OSHA provisions.

2.1.22 Sealer: Slow-drying sealer shall be a non-staining, clear, water dispersable type that remains tacky on the surface for a minimum of 8 hours for the purpose of trapping any residual airborne dust during the settling period. The product shall have flame spread and smoke development ratings both less than 50 and shall leave no stain when dry. Acceptable products: Borden Polyco 804, Double AD TC-55, equivalent or better. Also referred to as “Lockdown Agent”.

2.1.23 Shower: General shower shall be of the walk through type to permit use by one person at a time. Receive approval from the Owner before erecting a shower system.

2.1.23.1 Shower Enclosure: Shower enclosure shall be of a minimum 24 gauge steel walls with baked enamel, galvanized steel, aluminum or stainless steel finish, 16 gauge floor with porcelain enamel finish, brass drain and tapping for mixing valve. Shower installation shall be complete with globe valve for tempered water with a showerhead complete with orifice to restrict the flow to 2.5 USGPM.

2.1.23.2 Shower Pan: Provide one piece waterproof shower pan of minimum size 4' x 8' by 6" deep. Fabricate from seamless fibreglass minimum 1/16" thick reinforced with wood, 18 ga. stainless or galvanized steel with welded seems or, copper or lead with soldered seams.

2.1.23.3 Shower Head and Controls: Provide a factory-made showerhead producing a spray of water that can be adjusted for spray size and intensity. Feed shower separately with water from hot and cold supply lines. Arrange so that control of water temperature, flow rate, and shut off is from inside shower without outside aid.

2.1.23.4 Hose Bib: Provide heavy bronze angle type with wheel handle, vacuum breaker, and 3/4" National Standard male hose outlet.

2.1.23.5 Filters: The Abatement Contractor shall provide multi-stage cascaded filter units on drain lines from showers or any other water source carrying lead-contaminated water from the Lead-Abatement Work Area. Provide units with disposable filter elements where the primary filter passes particle 20 microns and smaller and the final filter passes particles 5 microns and smaller. Connect so that discharged water passes primary filter and output of primary filter passes through secondary filter.

2.1.24 Spray Cement: Spray adhesive in aerosol cans that is specifically formulated to stick tenaciously to sheet polyethylene.

2.1.25 Sump Pump: Provide totally submersible waterproof sump pump with integral float switch and shall have a manual switch. Provide unit sized to pump 2 times the flow capacity of all showers or hoses supplying water to the sump, through the filters specified herein when they are loaded to the extent that replacement is required. Provide unit capable of pumping debris, sand, plaster or other materials washed off during decontamination procedures without damage to mechanism of pump.

2.1.26 Tape: Reinforced cloth or fibreglass reinforced tape in 2" or 3" widths suitable for sealing polyethylene sheeting under both wet conditions, and dry conditions.

2.1.27 Temporary Lighting: Provide general service incandescent lamps or fluorescent lamps of wattage required for adequate illumination as required by the work. Protect lamps with guard cages grounded together to distribution panel or tempered glass enclosures.

2.1.28 Water Heater: ULC rated electric water heater appropriately sized for project to supply hot water for the Decontamination Unit shower. Activate from ground fault panel. Provide with relief valve compatible with water heater operation; pipe relief valve down to drip pan on floor with rigid piping. Drip pans shall consist of a 12" x 12" x 6" deep pan, made of 19 gauge galvanized steel, with handles.

3. EXECUTION

3.1 General Measures and Procedures

3.1.1 Washing facilities consisting of a wash basin, water, soap and towels shall be provided by the Abatement Contractor and workers shall use these washing facilities before eating, drinking, smoking or leaving the project.

3.1.2 Gloves shall be provided as necessary and the worker shall wear the gloves.

3.1.3 Use removal methods that minimize dust generation whenever possible.

3.1.4 Suppress any dust generated.

3.1.5 Workers shall not eat, drink, chew gum or smoke in the Lead-Abatement Work Area.

3.1.6 The Abatement Contractor shall clean up dust and waste frequently, and at regular intervals, and place the dust and waste in a container that is;

3.1.6.1 Dust tight,

3.1.6.2 Suitable for the type of waste,

3.1.6.3 Identified as containing lead waste,

3.1.6.4 Cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area, and

3.1.6.5 Removed from the workplace frequently and at regular intervals,

3.1.6.6 Evaluated for lead-content and disposed of in accordance with applicable regulations.

3.1.7 Clean-up after each operation shall be done to prevent lead contamination and exposure to lead.

3.1.8 The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.

3.1.9 Drop sheets shall be used below all lead operations which may produce dust, chips, or debris containing lead.

3.1.10 Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.

3.1.11 Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

3.1.12 Wet methods should be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

3.1.13 Dust and waste shall be cleaned up and removed by vacuuming with a HEPA filter equipped vacuum.

3.1.14 Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

3.1.15 All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or with a vacuum equipped with a HEPA filter, prior to removal from the work area.

3.1.16 Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.

3.1.17 Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation

3.1.18 The Lead-Abatement Work Area shall be inspected at least once daily by the Abatement Contractor to ensure that the Lead-Abatement Work Area is clean.

3.2 Measures and Procedures for Type/Class 1 Operations

3.2.1 All general measures and procedures shall be implemented.

3.2.2 Respirators should not be necessary if all general health and safety procedures are followed. However, any worker who requests a respirator shall be provided with a half-mask particulate respirator with N-, R- or P- series particulate filters, and 95, 99 or 100% efficiency, or better.

3.2.3 Coveralls should not be necessary if all general health and safety procedures are followed. However, any worker who requests coveralls shall be provided with coveralls and the worker shall wear the coveralls.

3.3 Measures and Procedures for Type/Class 2 A/B Operations

3.3.1 Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators based on the scope of the Operation) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.

3.3.2 Respirators shall be provided and the worker shall wear the respirator.

3.3.3 Gloves, coveralls and other Personal Protective Equipment (PPE) shall be provided and the worker shall wear the PPE.

3.3.4 Signage is required and the area shall be delineated to control access. Signs shall be posted in sufficient numbers to warn of the lead hazard and shall state in large clearly visible letters that, i) there is a lead hazard, and ii) access to the work area is restricted to persons wearing protective clothing.

3.3.5 Use removal methods that minimize dust generation whenever possible.

3.3.6 Suppress any dust generated.

3.3.7 Workers shall not eat, drink, chew or smoke in the work area.

3.3.8 Dust and waste shall be cleaned up at regular intervals and placed in a container that is;

3.3.8.1 dust tight,

3.3.8.2 suitable for the type of waste,

3.3.8.3 identified as lead waste,

3.3.8.4 cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,

3.3.8.5 removed from the workplace frequently and at regular intervals, and

3.3.8.6 evaluated for lead-content and disposed of in accordance with applicable regulations.

3.3.9 The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate to the type of waste. Double bagging of waste is recommended.

3.3.10 Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.

3.3.11 Air-handling (supply and return) systems servicing the area of the Class 2 Operation shall be removed from service or isolated to prevent migration of lead through the air handling system.

3.3.12 Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.

3.3.13 Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

3.3.14 Wet methods shall be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

3.3.15 Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

3.3.16 All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or using a vacuum equipped with a HEPA filter, prior to removal from the work area.

3.3.17 Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.

3.3.18 Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.

3.3.19 Where a dust generating operation is carried out, additional local mechanical ventilation shall be provided to remove dust, mist and fumes at the source. Local mechanical ventilation is recommended for welding, burning or high temperature cutting and for the removal of lead-containing and lead-based paints and surface coatings using power tools that are equipped with a dust collection device attached to a HEPA filter. Where local mechanical ventilation is used, the following should be met:

3.3.19.1 Air velocity at the source of dust, mist or fume generation shall be no less than 0.5 m/sec (100 ft./min).

3.3.19.2 Air discharged from the local mechanical ventilation system shall pass through a HEPA filter.

3.4 Measures and Procedures for Type/Class 3 A/B Operations

3.4.1 A competent supervisor must be present at all times during Class 3 Operations. Only workers and supervisors with proper training shall perform Class 3 Operations.

3.4.2 Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.

3.4.3 Respirators shall be provided and the worker shall wear the respirator.

3.4.4 Gloves, coveralls and other PPE shall be provided and the worker shall wear the PPE.

3.4.5 Signage is required and the area shall be delineated to control access. Signs shall be posted in sufficient numbers to warn of the lead hazard and shall state in large clearly visible letters that, i) there is a lead hazard, and ii) access to the work area is restricted to persons wearing protective clothing.

3.4.6 Use removal methods that minimize dust generation whenever possible.

3.4.7 Suppress any dust generated.

3.4.8 Workers shall not eat, drink, chew or smoke in the work area.

3.4.9 Dust and waste shall be cleaned up at regular intervals and placed in a container that is,

3.4.9.1 dust tight,

3.4.9.2 suitable for the type of waste,

3.4.9.3 identified as lead waste,

3.4.9.4 cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,

3.4.9.5 removed from the workplace frequently and at regular intervals, and

3.4.9.6 evaluated for lead-content and disposed of in accordance with applicable regulations.

3.4.10 The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.

3.4.11 Enclosures shall be used to separate the work area from other construction activities or work areas, and to prevent lead exposure to persons not directly involved in the lead operation. Barriers should only be used where full and partial enclosures are not practicable.

3.4.12 Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.

3.4.13 For Class 3a operations conducted indoors where work areas are not accessible to the public, barriers, partial enclosures, or full enclosures may be used.

3.4.14 For all other all other Class 3 operations conducted indoors full enclosures shall be used.

3.4.15 For Class 3a and 3b operations conducted outdoors, barriers, partial enclosures, or full enclosures shall be provided.

3.4.16 ***Barriers, Partial Enclosures and Full Enclosures***

3.4.16.1 Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, barriers can be used to restrict access to only workers who are adequately protected with proper PPE, and prevent entry of individuals not directly involved in the operation. Ropes or barriers shall be placed at a distance far enough from the operation that allows the lead-containing dust to settle. If this is not achievable, warning signs shall be posted at the distance where the lead-containing dust settles to warn that access is restricted to persons wearing PPE. Ropes or barriers shall be located no less than 10 metres from the work area.

3.4.16.2 Partial enclosures may consist of vertical and/or horizontal tarps and drop sheets (e.g. polyethylene sheeting). The tarps shall overlap and be securely fixed together at the seams. A partial enclosure is not a recommended containment system if significant dust is being generated, however is suitable for containing flakes and chips.

3.4.16.3 Full enclosures are tight enclosures (with tarps that are generally impermeable (e.g. polyethylene sheeting) with fully sealed joints and chambered air lock entryways/exits and upper seals). Full enclosures allow minimal or no fugitive emissions to reach the area outside the enclosure. For full enclosures, the following requirements shall be met:

3.4.16.3.1 The enclosure shall be made of windproof materials that are impermeable to dust.

3.4.16.3.2 The enclosure shall be supported by a secure, adequate and safe structure.

3.4.16.3.3 All joints in the enclosure shall be fully sealed.

3.4.16.3.4 Entrances to the enclosure shall be equipped with air locks (curtain walls, flap doors, zipper doors or solid doors).

3.4.16.3.5 The escape of dust, mist, fume, waste, blast media and debris from the enclosure shall be prevented.

3.4.16.3.6 General mechanical ventilation shall be provided by a HEPA filtered unit to remove contaminated air from the enclosure. Clean and safe make-up air that is free from hazardous dust, mist, vapours or fumes shall be provided to replace the exhausted air.

3.4.16.3.7 Filters used on ventilation equipment shall be adequate to ensure that exhausted air quality meets applicable environmental legislation and standards.

3.4.16.3.8 The air velocity within the enclosure shall provide an average minimum cross-draft or down-draft past each worker during abrasive blasting operations as follows.

3.4.16.3.8.1 cross draft capture velocity of 0.5 m/sec (100 ft./min) at the worker breathing zone.

3.4.16.3.8.2 Down draft capture velocity of 0.25 m/sec (50 ft./min) at the worker breathing zone.

3.4.17 The spread of lead dust from the work area shall be prevented by creating and maintaining within the enclosed area a minimum negative air pressure of 0.02 inches of water column (5 pascal), relative to the area outside the enclosed work area and/or 6 air changes per hour. Pressure differential readings must be taken and logged at regular intervals during lead removal.

3.4.18 Air-handling systems (supply and return) servicing the area of the Class 3 Operation shall be removed from service or isolated to prevent migration of lead through the air handling system.

3.4.19 Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.

3.4.20 Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

3.4.21 Wet methods shall be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

3.4.22 Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

3.4.23 All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or using a vacuum equipped with a HEPA filter, prior to removal from the work area.

3.4.24 Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.

3.4.25 Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.

3.4.26 Where a dust generating operation is carried out, additional local mechanical ventilation shall be provided to remove dust, mist and fumes at the source. Local mechanical ventilation is recommended for welding, burning or high temperature cutting and for the removal of lead-containing and lead-based paints and surface coatings using power tools that are not equipped with a dust collection device attached to a HEPA filter. Where local mechanical ventilation is used, the following should be met:

3.4.26.1 Air velocity at the source of dust, mist or fume generation shall be no less than 0.5 m/sec (100 ft./min).

3.4.26.2 Air discharged from the local mechanical ventilation system shall pass through a HEPA filter.

3.4.27 ***Class 3 Decontamination Facility***

3.4.28 Establishing a decontamination facility is required for workers conducting Class 3 operations. The decontamination facility shall be located as close as practicable to the work area and shall consist of:

3.4.29 A suitable area for taking off contaminated protective clothing.

3.4.30 A shower that includes;

3.4.30.1 Hot and cold water with individual controls inside the room to regulate water flow and temperature; or

3.4.30.2 Water of a constant temperature that is not less than 40° Celsius or more than 50° Celsius.

3.4.30.3 Clean towels.

3.4.30.4 Soap that is suitable for removing lead, and

3.4.30.5 Hygiene indicators to visually confirm that lead has been removed from workers hands.

3.4.31 A suitable area for changing in to street clothes and for storing clean clothing and equipment

3.5 Measures and Procedures for Cleaning of Lead Dust

3.5.1 Should contamination be discovered, either by visual inspections or by results of air sample analysis, clean-up of effected areas shall be cleaned by the Abatement Contractor using the procedures of this Section. All general measures and procedures and measures for Type 2 Operations shall be implemented.

3.5.1.1 Using vacuums equipped with HEPA filters, the Abatement Contractor shall clean all surfaces prior to using detergent solution.

3.5.1.2 The Abatement Contractor shall clean and rinse all hard surfaces by any one, or combination, of the following methods: Container, rinse bucket and clean rags; OR spray bottle, rinse bucket and clean rags; OR Mop and two buckets.

3.5.1.3 For porous and other hard-to-clean surfaces, the Abatement Contractor shall scrub surfaces with detergent solution and allow soaking for 10 minutes prior to rinsing. In addition to pre-cleaning with vacuums equipped with HEPA filters, hard-to-clean or very dirty surfaces may require additional pre-cleaning with heavy duty or degreasing detergent.

3.5.1.4 Regardless of chosen methodology, the Abatement Contractor shall work from top to bottom (i.e. from deck to floor), beginning in the farthest point of entry into the work enclosure.

3.5.1.5 The Abatement Contractor shall clean and rinse all mechanical, electrical components and conduits.

3.5.1.6 The Abatement Contractor shall clean and rinse any exposed structural components (i.e. deck, exposed beams, columns, etc.).

3.5.1.7 The Abatement Contractor shall clean and rinse a small area at a time before doing the next area.

3.5.1.8 When using rags, the Abatement Contractor shall use folding technique to expose fresh rag for cleaning. Rinse rag in clean water prior to solution application. Frequently, and at regular intervals, replace soiled rags with clean rags.

3.5.1.9 Frequently, and at regular intervals, the Abatement Contractor shall dispose of dirty water and use clean rinse water.

3.5.1.10 The Abatement Contractor shall complete final rinsing with clean water.

3.5.1.11 The Abatement Contractor shall avoid re-contamination of clean areas.

3.5.2 The Abatement Contractor shall clean the deck surface and all surfaces within the Lead-Abatement Work Area.

3.5.3 The Abatement Contractor shall dispose of as lead waste, all materials that may be contaminated with lead dust (i.e. rags and/or un-restorable items).

3.6 Preparation Prior to Contamination

3.6.1 The Abatement Contractor shall move equipment, tools, supplies and stored materials that can be moved without disturbing lead dust.

3.6.1.1 The Abatement Contractor shall erect polyethylene hoarding walls to separate the Work from any Occupied Area.

3.6.2 The Abatement Contractor shall pre-clean all surfaces in the Lead-Abatement Work Area, using a HEPA vacuum or damp cloth prior to installing protection.

3.6.3 The Abatement Contractor shall remove fixtures, equipment etc. specified to be removed, and that can be removed without disturbing the lead dust.

3.6.4 The Abatement Contractor shall seal all below ceiling openings to Lead-Abatement Work Area using polyethylene, tape, caulking, etc., including but not limited to windows, doors, vents, diffusers, etc.

3.6.5 The Abatement Contractor shall seal all openings in floor using plugs, tape, caulking, rip-proof polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene. Include floors of duct and service shafts.

3.6.6 The Abatement Contractor shall maintain emergency and fire exits from Lead-Abatement Work Area, or establish alternative exits satisfactory to Fire Commissioner of Canada and Provincial Fire Marshall.

3.6.7 The Abatement Contractor shall provide a fire extinguisher at each emergency exit and in both sides of the decontamination facilities.

3.6.8 The Abatement Contractor shall install temporary lighting in all Lead-Abatement Work Areas at levels that will provide for a safe and efficient use of the Lead-Abatement Work Area. Install battery powered emergency lights so as to light exit routes through Lead-Abatement Work Area.

3.6.9 The Abatement Contractor shall install a minimum of 1 layer of rip proof polyethylene over floor surfaces. Extend floor protection a minimum of 12" up all vertical surfaces in the Lead-Abatement Work Area. If more than 1 layer is used, each layer of polyethylene is to be laid and sealed independently of each other.

3.6.10 The Abatement Contractor shall install 2 layers of polyethylene all walls forming the perimeter of the Lead-Abatement Work Area. Each layer of polyethylene is to be laid and sealed independently of each other. Overlap floor polyethylene with wall polyethylene by a minimum of 12” (305 mm) at each layer.

3.6.11 The Abatement Contractor shall isolate at panel and disconnect or ground existing power supply to Lead-Abatement Work Area where necessary. Power supply to remaining areas of building must not be disrupted during work of this section.

3.6.12 The Abatement Contractor shall not proceed with work of Contaminated Preparation without obtaining written permission from the Environmental Consultant. The Abatement Contractor shall provide a minimum of 24 hours notice to consultant for the need of an inspection.

3.7 Contaminated Preparation

3.7.1 The Abatement Contractor shall use full personal protective procedures and equipment, and HEPA vacuums during contaminated preparation.

3.7.2 The Abatement Contractor shall shut down HVAC systems affecting the Lead-Abatement Work Area after normal building operating hours only.

3.7.3 The Abatement Contractor shall remove and dispose of obstructions to access ducts supplying into and exhausting from the Lead-Abatement Work Area.

3.7.4 The Abatement Contractor shall seal ducts supplying into and exhausting from the Lead-Abatement Work Area during one shift.

3.7.4.1 The Abatement Contractor shall clean outside and seal duct or equipment with rip-proof polyethylene and other products so as to make air tight.

3.7.4.2 The Abatement Contractor shall smoke test seals regularly.

3.8 Lead-Abatement Work Area Dismantling

3.8.1 The Abatement Contractor shall remove all polyethylene, tape, polyurethane foam, caulking and enclosures from Lead-Abatement Work Area.

3.8.2 The Abatement Contractor shall remove lead contaminated floor polyethylene by carefully rolling away from walls to centre of the Lead-Abatement Work Area.

3.8.3 The Abatement Contractor shall remove visible dust or residue found during removal of polyethylene using a HEPA vacuum.

3.8.4 The Abatement Contractor shall place Polyethylene, tape, cleaning material, clothing and other contaminated waste in lead waste containers and dispose of as lead waste.

3.8.5 The Abatement Contractor shall seal vacuum hoses and fittings, flexible ductwork and all tools used in contaminated work site in 6 mil polyethylene bags prior to removal from Lead-Abatement Work Area.

3.8.6 The Abatement Contractor shall decontaminate equipment used in Lead-Abatement Work Area, or double bag for transportation prior to being removed from Lead-Abatement Work Area.

3.8.7 The Abatement Contractor shall remove polyethylene protection and hoarding walls where hoarding walls separate occupied areas from Lead-Abatement Work Area.

3.8.8 The Abatement Contractor shall wash and mop with clean water all surfaces in the Lead-Abatement Work Area.

3.8.9 The Abatement Contractor shall remove all temporary lights, ground fault panels.

3.8.10 The Abatement Contractor shall maintain all hoarding walls adjacent to areas where lead dust is present.

3.8.11 The Abatement Contractor shall damp mop and clean with HEPA vacuum Occupied Areas previously below platforms, tunnels and decontamination facilities with HEPA vacuum.

3.8.12 Prior to leaving the work area,

3.8.12.1 Workers shall decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing.

3.8.12.2 Remove protective clothing by rolling the clothing outward and downward onto itself so the clean interior of the protective clothing is on the exterior after removal.

3.8.12.3 Workers shall remove all contaminated clothing and equipment except respirator.

3.8.12.4 If the protective clothing is to be reused, it shall be stored in a sealable plastic bag by the worker.

3.8.12.5 If the protective clothing will NOT be reused, the worker shall place it in a lead waste container immediately prior to leaving the work area.

3.8.12.6 Immediately after leaving the work area, all workers shall proceed directly to the established washing facilities to wash hands and face while wearing the respirator.

3.8.12.7 Workers shall wash exposed skin and respirator with soap and water.

3.8.12.8 All workers shall wash, remove and store respirators as per the written procedures that have been established by the employer and as is consistent with the manufacturer's specifications. Respirator filters for re-use shall be removed from respirators prior to washing the respirator or shall be disposed of as lead waste.

End of Section

LIST OF CONTENTS

Page

1. GENERAL 2

1.1 General and Related Work 2
1.2 Definitions 2
1.3 Worker and Visitor Protection 4
1.4 Visitor Protection 5
1.5 Air Monitoring 5
1.6 Waste Transport And Disposal 6

2. PRODUCTS 6

2.1 Materials and Equipment 6

3. EXECUTION 8

3.1 General Precautions 8
3.2 Acrylonitrile 9
3.3 Arsenic 9
3.4 Benzene 10
3.5 Coke Oven Emissions 10
3.6 Ethylene Oxide 10
3.7 Isocyanates 10
3.8 Mercury 10
3.9 Mould 14
3.10 Silica 14
3.11 Vinyl Chloride Monomer 18

1. GENERAL

1.1 General and Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere:

Division 2	Section 02 82 00	Abatement Scope and Details
Division 2	Section 02 82 01	Type 1 Asbestos Abatement
Division 2	Section 02 82 02	Type 2 Asbestos Abatement
Division 2	Section 02 82 04	Type 3 Asbestos Abatement
Division 2	Section 02 83 00	Lead Abatement
Division 2	Section 02 84 00	PCB Capacitors and Ballasts

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 The Construction Contractor is responsible to verify all measurements for removal, cleaning, and re-insulation purposes. Measurements and quantities provided herein are for reference only.

1.1.4 It is the intent that abatement performed as per this section will result in the removal and disposal of all hazardous materials as well as any materials that may have been contaminated either during or prior to work of this Section.

1.1.5 Refer to Section 02 82 00, Abatement Scope and Details, for the following information and requirements;

1.1.5.1 Site Conditions,

1.1.5.2 Outline of Work,

1.1.5.3 Schedule,

1.1.5.4 Supervision,

1.1.5.5 Quality Assurance,

1.1.5.6 Regulations,

1.1.5.7 Notification, and

1.1.5.8 Submittals.

1.2 Definitions

1.2.1 Air Monitoring: The process of measuring the concentration of a substance in a specific volume of air.

1.2.2 Authorized Visitor(s): The Contracting Authority or his approved representative and/or persons representing regulatory agencies.

1.2.3 Clean Area: Either an operating area or an area in which removal work has already been completed.

1.2.4 Competent Personnel: a worker who is qualified because of knowledge, training and experience to perform the work; is familiar with the Ontario Occupational Health and Safety Act and with the provisions of the regulations that apply to the work, and; has knowledge of all potential or actual danger to health or safety in the work.

1.2.5 DOP / PAO Test: Dioctylphthalate / Poly Alpha Olefin aerosol challenge of a HEPA filter system and is used to establish the integrity and effectiveness of the system to filter out particles and dust.

1.2.6 Filter: A media component used in respirators, vacuum cleaners or negative pressure filter fan units to remove solid or liquid particles from the inspired air.

1.2.7 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.

1.2.8 HEPA Vacuum: High Efficiency Particulate Aerosol filtered vacuum equipment acceptable to local provincial Ministry of Labour, and Health and Welfare Canada. Ensure vacuums are equipped with hoses, fittings, and nozzle attachments. Maintain vacuum equipment and system properly.

1.2.9 Occupied Area: Any area of the Existing Facilities outside the Abatement Work Area.

1.2.10 Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

1.2.11 Type 1 Silica Operations: Defined by the Ministry of Labour document "*Guideline - Silica on Construction Projects"*, dated April 2011, includes the following operations:

1.2.11.1 The drilling of holes in concrete or rock that is not part of a tunneling operation or road construction.

1.2.11.2 Milling of asphalt from concrete highway pavement.

1.2.11.3 Charging mixers and hoppers with silica sand (sand consisting of at least 95 per cent silica) or silica flour (finely ground sand consisting of at least 95 per cent silica).

1.2.11.4 Any other operation at a project that requires the handling of silica-containing materials in a way that may result in a worker being exposed to airborne silica.

1.2.11.5 Entry into a dry mortar removal or abrasive blasting areas while airborne dust is visible for less than 15 minutes for inspection and/or sampling.

1.2.11.6 Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.

1.2.12 Type 2 Silica Operations: Defined by the Ministry of Labour document "*Guideline - Silica on Construction Projects"*, dated April 2011, includes the following operations:

1.2.12.1 Removal of silica containing refractory materials with a jackhammer.

1.2.12.2 The drilling of holes in concrete or rock that is part of a tunnelling or road construction.

1.2.12.3 The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials.

1.2.12.4 The use of a power tool to remove silica containing materials.

1.2.12.5 Tunnelling (operation of the tunnel boring machine, tunnel drilling, tunnel mesh installation).

1.2.12.6 Tuckpoint and surface grinding.

1.2.12.7 Dry mortar removal with an electric or pneumatic cutting device.

1.2.12.8 Dry method dust cleanup from abrasive blasting operations.

1.2.12.9 The use of compress air outdoors for removing silica dust.

1.2.12.10 Entry into area where abrasive blasting is being carried out for more than 15 minutes.

1.2.13 Type 3 Silica Operations: Defined by the Ministry of Labour document "*Guideline - Silica on Construction Projects"*, dated April 2011, includes the following operations:

1.2.13.1 Abrasive blasting with an abrasive that contains $\geq$ 1 per cent silica.

1.2.13.2 Abrasive blasting of a material that contains $\geq$ 1 per cent silica.

1.2.14 Work: Includes all services, labour and material required to complete the work as specified in the contract.

1.2.15 Work Area(s): Area(s) where work takes place that will, or may disturb hazardous materials.

1.3 Worker and Visitor Protection

1.3.1 Prior to commencing work, the Construction Contractor shall instruct workers in all aspects of work procedures and protective measures.

1.3.2 The Construction Contractor shall provide workers and visitors with protective clothing and equipment where contact with hazardous materials may occur.

1.3.3 The Construction Contractor shall provide workers and visitors with clothing and equipment appropriate for the potential level of exposure.

1.3.4 Before commencing work, the Construction Contractor shall provide satisfactory proof that every worker has had instruction and training in hazardous material exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

1.3.5 The Construction Contractor shall provide workers with instruction and training on respirators. This includes:

1.3.5.1 Limitations of equipment,

1.3.5.2 Inspection and maintenance of equipment,

1.3.5.3 Fitting of equipment, and

1.3.5.4 Disinfecting of equipment.

1.3.6 **Instructions:** Before entering hazardous material work area(s), the Construction Contractor shall instruct workers and Authorized Visitor(s) in use of respirators, and all aspects of Work procedures and protective measures. Provide instruction by competent person as defined by The Occupational Health and Safety Act.

1.3.7 **Respirators:**

1.3.7.1 The Construction Contractor shall provide workers with personally issued and marked respirators appropriate for the hazardous material encountered. The Construction Contractor shall provide approved respirators to Authorized Visitor(s). The Construction Contractor shall provide sufficient filters and cartridges so workers can install new filters and cartridges following disposal of used filters and cartridges before re-entering contaminated areas. Respirators shall be acceptable to Occupational Health Branch of the Ministry of Labour.

1.3.7.2 The Construction Contractor shall provide instruction to users in use of respirators, including qualitative fit testing. No worker or Authorized Visitor(s) shall have facial hair that prevents proper contact between respirator face piece and skin. Alternatively, supplied air positive pressure respirator or supplied air positive pressure hood or helmet may be provided. The Construction Contractor shall maintain respirators in proper functioning and clean condition, or remove from Site.

1.3.8 Protective Clothing and Goggles: Workers and Authorized Visitor(s) shall wear personal protective apparel appropriate for the hazardous material encountered and as required by Ministry of Labour construction regulations.

1.3.9 Eating, drinking, chewing or smoking shall not be permitted in the work area.

1.3.10 Workers and Authorized Visitors shall wash hands and face when leaving hazardous material removal work area.

1.4 Visitor Protection

1.4.1 The Construction Contractor shall provide clean protective clothing and equipment and approved respirators to Authorized Visitors.

1.4.2 The Construction Contractor shall ensure that Authorized Visitors have received required training for entry into Work Areas.

1.5 Air Monitoring

1.5.1 Air monitoring, if completed, shall be performed following the National Institute for Occupational Safety and Health Methods, as is applicable for the hazardous material being assessed.

1.5.2 The Construction Contractor shall cooperate fully with the Environmental Consultant in the collection of air monitoring samples, including requiring workers to wear sampling pumps for a full work shift, if required. Workers shall exercise care not to damage sampling equipment.

1.5.3 If air monitoring shows a hazardous material removal work area is contaminated above levels acceptable levels, based upon Occupational Health and Safety exposure limits, the Construction Contractor shall stop work and notify Contracting Authority Designee for additional instructions.

1.6 Waste Transport And Disposal

1.6.1 The Construction Contractor shall ensure hazardous materials are treated, packaged, transported and disposed of as hazardous material.

1.6.2 The Construction Contractor shall drop garbage bins at designated locations. Keep bins covered and enclosed while at the site. Bin loading area shall be kept clean at all times.

1.6.3 The Construction Contractor shall pick-up and drop off garbage bins at pre-approved times, and shall not interfere with the Contracting Authority's operations.

1.6.4 The Construction Contractor shall conform to requirements of Regulations under Environmental Protection Act for Waste Management, transporting and disposal of hazardous waste.

1.6.5 The Construction Contractor shall ensure shipment of containers to dump is taken by waste hauler licensed to transport hazardous waste.

1.6.6 The Construction Contractor shall ensure that a bill of lading, showing the type and weight of hazardous waste being transported, is completed for each load.

1.6.7 The Construction Contractor shall check with dump operator to determine type of waste containers acceptable.

1.6.8 The Construction Contractor shall ensure dump operator is fully aware of hazardous material being dumped.

1.6.9 The Construction Contractor shall co-operate with Ministry of the Environment and Climate Change inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the Contracting Authority.

2. PRODUCTS

2.1 Materials and Equipment

2.1.1 The Construction Contractor shall ensure that all tools, equipment, materials and supplies brought to work site are in good condition and free of containing or being contaminated with hazardous materials.

2.1.2 The Construction Contractor shall ensure that disposable tools, equipment, materials and supplies are of new materials only.

2.1.3 Drop Sheet: Minimum 0.15 mm (6 mil) thick polyethylene unreinforced, or minimum 0.15 mm (6 mil) thick woven fibre reinforced fabric bonded both sides with polyethylene of size to minimize joints.

2.1.4 HEPA Filter: High Efficiency Particulate Aerosol filter at least 99.97 percent efficient in collecting 0.3 micrometer aerosol.

2.1.5 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. All air must be filtered by HEPA filter before discharge.

2.1.6 Negative Air Unit: Portable air handling system which extracts air directly from the Hazardous Material Work Area and discharges the air to the exterior of the Hazardous Material Work Area. Equipped as follows:

2.1.6.1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.

2.1.6.2 Pressure differential gauge to monitor filter loading.

2.1.6.3 Auto shut off and warning system for HEPA filter failure.

2.1.6.4 Separate hold down clamps to retain HEPA filter in place during change of pre-filter.

2.1.7 Negative Pressure: Reduced pressure within work area(s) established by extracting air directly from work area, and discharging it directly to exterior of the Facility. Discharged air first passes through HEPA filter. Extract sufficient air to ensure constant reduced pressure at perimeter of work area with respect to surrounding areas.

2.1.7.1 Establishing Negative Pressure: Distribute negative air filter/fan units evenly around the Hazardous Material Work Area. Remove windows, if required, and replace with 1/2" plywood with appropriately sized openings for exhaust. Switch the negative air pressure system to the "ON" mode and operate continuously until final completion of the work, including final cleanup. Exhaust air to the outside of the Facility using sealed ducting. A spare negative air unit will be fully installed and ready to operate as a backup unit. The negative air pressure system must have the capacity to exchange air volume of the work area three times per hour and maintain a minimum of 0.02 inches of water gauge differential. Operate negative pressure system continuously from the time the first polyethylene is installed to seal openings until final completion of the work including final cleanup and air testing. Replace pre-filters and HEPA filters as required and on a regular basis to maintain even and constant draw across negative air unit. Do not discharge negative air ducting with-in 25 feet of the Facility access points. Replace windows removed for discharge panels upon completion of project, if window removal was required.

2.1.8 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.

2.1.8.1 Fibre-Reinforced (Rip-Proof) Polyethylene Sheeting: 8 mil (0.20mm) fabric made up from one layer of 5 mil (0.13 mm) weave and two layers of 1.5 mil (0.04 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.

2.1.8.2 Flame-Resistant Polyethylene Sheeting: A single polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films, 6 mil (0.15 mm) thickness.

2.1.9 Protective Coveralls: Disposable full body coveralls complete with hoods manufactured of a material that does not permit penetration of asbestos fibres or other hazardous materials.

3. EXECUTION

3.1 General Precautions

3.1.1 Demolition construction work of materials found not to contain, or not suspected of containing any hazardous materials shall be completed using (at a minimum) general worker health and safety precautions which includes, in part, appropriate dust suppression methods and proper respiratory protection.

3.1.2 The Construction Contractor shall prevent spread of dust from work area using measures appropriate to work to be completed.

3.1.3 The Construction Contractor shall perform work in manner to reduce dust creation to lowest levels practicable. Work is subject to visual inspection and air monitoring. Any contamination of surrounding areas indicated by visual inspection or air monitoring shall require complete enclosure and clean-up of affected areas

3.1.4 Washing facilities consisting of a wash basin, water, soap and towels shall be provided by the Construction Contractor and workers shall use these washing facilities before eating, drinking, smoking or leaving the project.

3.1.5 Gloves shall be provided as necessary and the worker shall wear the gloves.

3.1.6 Use removal methods that minimize dust generation whenever possible.

3.1.7 Suppress any dust generated.

3.1.8 Workers shall not eat, drink, chew gum or smoke in the Work Area.

3.1.9 The Construction Contractor shall clean up dust and waste frequently, and at regular intervals, and place the dust and waste in a container that is;

3.1.9.1 Dust tight,

3.1.9.2 Suitable for the type of waste,

3.1.9.3 Identified as containing waste,

3.1.9.4 Cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area, and

3.1.9.5 Removed from the workplace frequently and at regular intervals,

3.1.9.6 Disposed of in accordance with applicable regulations.

3.1.10 Clean-up after each operation shall be done to prevent spread of waste.

3.1.11 The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.

3.1.12 Drop sheets shall be used below all operations which may produce dust, chips, or debris.

3.1.13 Dry removal of materials shall be minimized whenever possible.

3.1.14 Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

3.1.15 Wet methods should be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

3.1.16 Dust and waste shall be cleaned up and removed by vacuuming with a HEPA filter equipped vacuum.

3.1.17 Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

3.1.18 All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or with a vacuum equipped with a HEPA filter, prior to removal from the work area.

3.1.19 Protection of porous or fibrous surfaces is imperative as it is very difficult to remove dust from these surfaces. If the material cannot be adequately protected from dust it shall be removed and disposed of.

3.1.20 Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation

3.1.21 The Work Area shall be inspected at least once daily by the Construction Contractor to ensure that the Work Area is clean

3.2 Acrylonitrile

3.2.1 Acrylonitrile may be present in stable form within paints, adhesives, and piping (i.e. black plumbing piping known as ABS (Acrylonitrile Butadiene Styrene) piping) in the Work Area.

3.2.2 During demolition work, the management of acrylonitrile compounds, if present in paint finishes, can be adequately addressed utilizing standard best practices for dust control and general health and safety precautions.

3.2.3 If present on-site in adhesives or as piping, these stable forms of acrylonitrile would not be expected to be a health & safety concern during routine demolition work.

3.3 Arsenic

3.3.1 Arsenic would not be expected in the Work Area and was not noted during previous investigations.

3.3.2 Arsenic compounds, however, may be present in paints and adhesives.

3.3.3 During demolition work, the management of arsenic compounds, if present in paint finishes, can be adequately addressed utilizing standard best practices for dust control and general health and safety precautions.

3.4 Benzene

3.4.1 Benzene would not be expected in the Work Area and was not observed during previous investigations. However, benzene may be present in stable form as a constituent within roofing materials, paints and adhesives.

3.4.2 During demolition work, the management of benzene compounds, if present in roofing materials, paints and adhesives, can be adequately addressed utilizing standard best practices for dust control and general health and safety precautions.

3.5 Coke Oven Emissions

3.5.1 Coke Oven Emissions would not be expected in the Work Area and was not observed during previous investigations.

3.6 Ethylene Oxide

3.6.1 Ethylene oxide would not be expected in the Work Area and was not observed during previous investigations.

3.7 Isocyanates

3.7.1 Free isocyanate compounds would not be expected in the Work Area and were not noted during previous investigations.

3.7.2 Historically, these compounds are known to have been present in paint finishes.

3.7.3 During demolition work, the management of these compounds, if present in paint finishes, can be adequately addressed utilizing standard best practices for dust control and general health and safety precautions.

3.8 Mercury

3.8.1 Mercury is present in minor quantities within the Work Area in the following forms:

3.8.1.1 Vapour within fluorescent light tubes or compact fluorescent bulbs,

3.8.1.2 Liquids within glass ampules associated with thermostats, switches and switchgears, pressure and/or temperature gauges, flow relays, pressure transmitter units, etc., and

3.8.1.3 Mercury may also be present as a constituent of paints and adhesives.

3.8.2 The Construction Contractor shall collect all mercury-containing items (fluorescent light tubes, thermostats, etc.) from the Facility in a central location. All mercury-containing items shall be submitted to a qualified recycling facility for mercury reclamation.

3.8.3 The Construction Contractor shall store and transport mercury-containing items in a manner to avoid incidental breakage.

3.8.4 In the event of incidental breakage, the Construction Contractor shall implement the procedures below as applicable for site-specific circumstances.

3.8.5 During demolition work, the management of these compounds, if present in paint finishes, can be adequately addressed using safety precautions utilized during the removal or demolition of painted surfaces.

3.8.6 **General Measures and Procedures for Mercury Work**

3.8.6.1 Avoid direct skin contact with mercury and avoid inhalation of mercury vapour.

3.8.6.2 Have a mercury spill kit available on-site when doing work.

3.8.6.3 Removal of mercury-containing items should be completed with the item sealed and intact at all times.

3.8.6.4 Store and transport mercury-containing items in a manner to avoid incidental breakage.

3.8.6.5 Transport and disposal of mercury-containing items to be completed following Regulatory requirements and submitted to qualified recycling facility for mercury reclamation.

3.8.7 **Response in the event of a spill**

3.8.7.1 **DO NOT** use a vacuum cleaner to clean up mercury. Vacuuming a mercury spill will increase the mercury vapor in the air and increase the likelihood of exposure. Any vacuum cleaner used for cleanup will become contaminated and will need to be discarded as hazardous waste.

3.8.7.2 **DO NOT** use a broom to clean up mercury. The broom will break the mercury into smaller droplets and spread them around a larger area, making it more difficult to find and clean up.

3.8.7.3 **DO NOT** pour mercury down a drain. This could contaminate the plumbing system and the sewage system.

3.8.7.4 **DO NOT** walk out of the spill area in shoes or clothes that may have become contaminated with mercury.

3.8.7.5 **DO NOT** put contaminated items in the washing machine as this may contaminate the machine and sewage system.

3.8.7.6 Check to see if mercury was splashed on any person or their clothing. If so, carefully remove all contaminated clothing, including shoes, and place in a sealed bag before leaving the spill area. Mercury on the skin should be carefully wiped off with a damp paper towel.

3.8.7.7 Evacuate and isolate the spill area to ensure that people and pets are kept well away from the spill.

3.8.7.8 If any mercury was ingested, contact your local poison control centre.

3.8.7.9 Close interior doors leading to other indoor areas.

3.8.7.10 Open windows and exterior doors to ventilate the area.

3.8.7.11 Turn off any ventilation that could circulate air from the spill site to other indoor areas. This may involve turning down heaters or air conditioners and turning off fans.

3.8.7.12 Turn down the thermostat in order to minimize mercury vaporisation.

3.8.7.13 Stop the spread of mercury by blocking the spill with damp rags. Prevent mercury droplets from entering cracks or rolling under cabinets and other items.

3.8.8 **Mercury Cleanup Procedures for Hard and Smooth Surfaces**

3.8.8.1 Follow Procedures as applicable in previous sections.

3.8.8.2 Prepare for cleanup by assembling appropriate supplies, such as,

3.8.8.2.1 rubber, nitrile or latex gloves,

3.8.8.2.2 protective eyewear or safety glasses

3.8.8.2.3 ziploc bags,

3.8.8.2.4 rubber squeegee or two pieces of paper or cardboard,

3.8.8.2.5 plastic dust pan,

3.8.8.2.6 wide-mouth plastic container with a lid,

3.8.8.2.7 garbage bags,

3.8.8.2.8 damp paper towels and/or rags,

3.8.8.2.9 duct tape, masking tape, or packing tape,

3.8.8.2.10 large tray or box,

3.8.8.2.11 flashlight,

3.8.8.2.12 tweezers,

3.8.8.2.13 eye dropper, and

3.8.8.2.14 other tools and supplies necessary for the given circumstance.

3.8.8.3 Don disposable coveralls with integral hood, boot covers and elasticized cuffs (e.g. Tyvek or equivalent).

3.8.8.4 Remove all jewelry (re: as mercury may bond with the metal).

3.8.8.5 Put on gloves and protective eyewear or safety glasses.

3.8.8.6 Using stiff paper, cardboard, or a rubber squeegee, and using slow sweeping motions, push the mercury beads together from the furthest point of the spill towards the middle of the spill. Gently push the beads onto a plastic dust pan or draw them into an eye dropper.

3.8.8.7 Use a flashlight to check for any remaining mercury droplets that may have been missed. Hold the flashlight at a low angle close to the floor, and other horizontal surfaces if affected, in a darkened room and look for additional glistening beads of mercury that may be sticking to the surface or in small cracked areas of the surface.

NOTE: Mercury can move surprising distances on hard and flat surfaces. Inspection is required of the entire spill area.

3.8.8.8 Very carefully pour the mercury droplets into a wide-mouth container and secure the lid.

3.8.8.9 Use the sticky side of tape to pick up any droplets that could not be picked up with the cardboard. Place the tape on a paper towel, fold, and place in a plastic bag that can be sealed.

3.8.8.10 If the mercury spill involves broken glass, carefully pick up the glass pieces using tweezers. Place the glass pieces on the paper towel, fold, and place in a sealed plastic bag. Small pieces of glass can be picked up using sticky tape, such as duct tape.

3.8.8.11 Pour or transfer collected mercury into a large mouth container slowly and carefully. This should be done over a large tray or box lined with plastic to prevent spillage. Close the container with an air tight lid and seal with tape. Place inside a sealable bag and seal.

3.8.8.12 Dispose of all items that may have been contaminated with mercury. Supplies used for cleanup, as well as any contaminated clothing, protective clothing, shoes, and gloves, should be placed in garbage bags (double or triple wrapped) and sealed with tape. Contaminated items should be cleaned or disposed of in accordance with the Regulatory requirements.

3.8.8.13 Using soap, thoroughly wash hands and any other body parts that may have come into contact with the mercury.

3.8.8.14 Keep the work area isolated and ventilated for 24-to-48 hours after successful cleanup. Alternatively, post cleanup testing for mercury vapors can be completed to confirm that adequate cleanup has been completed and that the area is suitable for re-occupancy

3.8.9 **Mercury Cleanup Procedures for Other Surfaces and Items**

3.8.9.1 Follow Procedures as applicable in previous sections.

3.8.9.2 Don disposable coveralls with integral hood, boot covers and elasticized cuffs (e.g. Tyvek or equivalent).

3.8.9.3 Remove all jewelry (re: as mercury may bond with the metal).

3.8.9.4 Put on gloves and protective eyewear or safety glasses.

3.8.9.5 Porous items, such as clothing, carpets, upholstery, etc., may be very difficult to remove all mercury. Mercury in these items may collect in the fibers and backing materials.

3.8.9.6 Where possible, discard items and/or cut out contaminated section of porous materials.

3.8.9.7 If cleaning of porous materials is attempted, implement cleaning procedures as applicable in the previous sections. Post cleanup testing for mercury vapors should be completed after attempting to clean porous materials.

3.8.9.8 Where mercury may have seeped into porous or rough surfaces, and thorough cleaning is not possible, an encapsulation sealant can be applied as a management strategy.

3.8.9.9 During removal of plumbing (e.g. spills in sink drains), complete sink trap removal work over a tray or bucket. It is preferable to place the contaminated trap in a sealed plastic bag. If the old trap is not discarded, the contents of the trap should be poured into a wide-mouth, sealable jar and disposed of. The trap should then be thoroughly washed.

3.8.9.10 Dispose of all items that may have been contaminated with mercury. Supplies used for cleanup, as well as any contaminated clothing, protective clothing, shoes, and gloves, should be placed in garbage bags (double or triple wrapped) and sealed with tape. Contaminated items should be cleaned or disposed of in accordance with the Regulatory requirements.

3.8.9.11 Using soap, thoroughly wash hands and any other body parts that may have come into contact with the mercury.

3.8.9.12 Keep the work area isolated and ventilated for 24-to-48 hours after successful cleanup. Alternatively, post cleanup testing for mercury vapors can be completed to confirm that adequate cleanup has been completed and that the area is suitable for re-occupancy

3.9 Mould

3.9.1 Removal of mould-contaminated materials shall be completed in compliance with the following documents;

3.9.1.1 Canadian Construction Association, Standard Construction Document CCA 82, 2004; "*mould guidelines for the Canadian construction industry*" and the Environmental Abatement Council of Canada (EACC) document; "*Mould Abatement Guidelines*", Edition 3, 2015.

3.9.1.2 Environmental Abatement Council of Canada (EACC) document; "*Construction Worker Hygiene Practices Guideline*", dated 2014.

3.10 Silica

3.10.1 Free crystalline silica, in the form of common construction sand, is present in all concrete and masonry products within the Work Area.

3.10.2 **General Measures and Procedures for Silica Operations**

3.10.2.1 Clean-up after each operation is required to prevent dust containing silica from spreading.

3.10.2.2 Compressed air or dry sweeping should be avoided when cleaning a work area.

3.10.2.3 Compressed air should not be used for removing dust from clothing.

3.10.2.4 Workers exposed to silica should be provided with or have access to washing facilities equipped with clean water, soap, and individual towels.

3.10.2.5 Silica dust on personal protective clothing and equipment should be removed by damp wiping or HEPA vacuuming.

3.10.2.6 Contaminated personal protective clothing and equipment should be handled with care to prevent disturbing the silica dust and the generation of airborne silica dust.

3.10.2.7 Washing facilities and laundering procedures must be suitable for handling silica contaminated laundry.

3.10.2.8 Preparation of the Work Area

3.10.2.9 Warning signs should be posted in sufficient number to warn of the hazard. If it is an indoor operation, signs should be posted at each entrance to the work area. The signs should display the following information in large, clearly visible letters:

3.10.2.9.1 There is a silica dust hazard.

3.10.2.9.2 Access to the work area is restricted to authorized persons.

3.10.2.9.3 Respirators must be worn in the work area.

3.10.2.10 *Dust Control Measures*

3.10.2.11 The generation of airborne silica-containing dust should be controlled with a mechanical ventilation system, wetting, or the use of a dust collection system. If silica-containing airborne dust is generated, mechanical ventilation with an air flow sufficient to remove airborne contaminants from workers' breathing zone should be provided. The air flow of the mechanical ventilation system should be at least 50 cubic feet per minute per square foot of face area (0.25 m^3/s per square meter of face area). However, if it is determined that none of these methods are practical, workers may be provided with respirators to protect them from exposure. The following should be considered before assigning respirators:

3.10.2.11.1 Risk to workers using wetting or a dust collection system.

3.10.2.11.2 Likelihood of damage to equipment if wetting or a dust collection system is used.

3.10.2.11.3 Frequency and duration of the operation.

3.10.2.12 If compressed air is being used to remove silica-containing dust outdoors, the operator and workers within 25 metres of the work area who may be exposed to the dust must either be removed from the path of the dust cloud or provided with respirators.

3.10.2.13 Where effective dust control measures are in place and where an employer can demonstrate on a continual basis that the silica exposure levels are below the Occupational Exposure Limit, respirators may not be required

3.10.3 **Measures and Procedures for Type 1 Silica Operations**

3.10.3.1 Implement all general protective measures and procedures detailed in the previous section.

3.10.3.2 Half-mask particulate respirator with N-, R-, or P-series filter and 95, 99 or 100 per cent efficiency should be provided for workers performing Type 1 operations.

3.10.3.3 Respirators should also be provided when,

3.10.3.3.1 entering a dry mortar removal area with visible airborne dust for less than 15 minutes for the purposes of inspection and/or sampling purposes.

3.10.3.3.2 work is being performed within 25 metres of an outdoor area where silica-containing dust is being removed with compressed air

3.10.4 **Measures and Procedures for Type 2 Silica Operations**

3.10.4.1 Implement all general protective measures and procedures detailed in previous sections.

3.10.4.2 Respirators with a NIOSH APF of 50 should be provided for workers performing Type 2 operations.

3.10.4.3 The generation of silica-containing airborne dust should be controlled by thoroughly wetting the area prior to and/or during drilling or cutting operations and during the loading, scraping or moving of rock.

3.10.4.4 Other workers entering a work area where Type 2 operations are being performed should remain at least 10 metres away.

3.10.4.5 Ropes or barriers should be set up to prevent unauthorized personnel from entering the work area. If this is not possible and there are workers within the 10-metre limit, the Type 2 operation should be enclosed to prevent the escape of airborne silica-containing dust (i.e. Barriers, Partial Enclosures or Full Enclosures)

3.10.5 **Measures and Procedures for Type 3 Silica Operations**

3.10.5.1 Implement all general protective measures and procedures detailed in previous sections.

3.10.5.2 The operator of the abrasive blasting nozzle should wear a Type CE abrasive blast supplied air respirator operated in a pressure demand or positive pressure mode with a tight-fitting half-mask or full facepiece.

3.10.5.3 It is recommended that compressed air that is used to supply supplied air respirators meet the breathing air purity requirements of CSA Standard Z180.1-00. Where an oil-lubricated compressor is used to supply breathing air, a continuous carbon monoxide monitor/alarm should be provided.

3.10.5.4 While abrasive blasting is in progress or the airborne dust from abrasive blasting is visible,

3.10.5.4.1 any worker entering the work area where abrasive blasting is being carried out for less than 15 minutes for inspection and/or sampling purposes should wear a half-mask particulate respirator with N-, R-, or P-series filter and 95, 99 or 100 per cent efficiency.

3.10.5.4.2 any worker entering a work area where abrasive blasting is being carried out for more than 15 minutes should wear a respirator with a NIOSH APF of 50.

3.10.5.4.3 workers engaged in cleaning dust from abrasive blasting operations, should wear a respirator with a NIOSH APF of 50.

3.10.5.5 Where abrasive blasting is conducted, barriers, partial enclosures and full enclosures should be in place to prevent other workers from being exposed to silica-containing dust and to prevent the spread of dust to other work areas.

3.10.5.6 *Barriers, Partial Enclosures and Full Enclosures*

3.10.5.7 Barriers, partial enclosures, and full enclosures are used to separate the work area from the rest of the project, and in some cases, to prevent silica exposure to other workers not directly involved in the operation. Partial and full enclosures can also prevent or reduce the dispersion of silica into the surrounding work area and environment. Barriers should only be used where full and partial enclosures are not practicable.

3.10.5.8 *Barriers*

3.10.5.9 Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, they can be used to restrict access of workers who are not adequately protected with proper PPE, and also prevent the entry of workers not directly involved in the operation.

3.10.5.10 Ropes or barriers should be placed at a distance far enough from the operation that allows the silica-containing dust to settle. If this is not achievable, warning signs should be posted at the distance where the silica-containing dust settles to warn that access is restricted to persons wearing PPE.

3.10.5.11 For example, the removal of mortar and cutting operations, ropes or barriers should be located at least 10 metres away. All workers within the barrier or warning sign zone must be adequately protected.

3.10.5.12 *Partial Enclosures*

3.10.5.13 Partial enclosures allow some level of emission to the atmosphere outside of the enclosure.

3.10.5.14 Partial enclosures may consist of vertical tarps and floor tarps so long as the tarps are overlapped and securely fixed together at the seams.

3.10.5.15 A partial enclosure is not a recommended containment system if significant dust is being generated.

3.10.5.16 *Full Enclosures*

3.10.5.17 Full enclosures are tight enclosures (with tarps that are generally impermeable and fully sealed joints and entryways).

3.10.5.18 Full enclosures allow minimal or no fugitive emissions to reach the outside environment.

3.10.5.19 For full enclosures, the following requirements should be met.

3.10.5.19.1 entry ways in the enclosure should be equipped with air locks, overlapping door tarps or doors.

3.10.5.19.2 the enclosure should be supported by a secure structure.

3.10.5.19.3 all joints in the enclosure should be fully sealed

3.10.5.19.4 the escape of abrasive and debris from the enclosure should be controlled, at air supply points, by the use of baffles, louvers, flap seals and filters.

3.10.5.19.5 general mechanical ventilation should be provided to remove contaminated air from the enclosure and replacement air should be provided to replace the exhausted air

3.10.5.19.6 the air pressure within the enclosure should be negative relative to the outside.

3.10.5.19.7 equipment venting such air shall be equipped with filters adequate to control vented air to provincial environmental standards.

3.10.5.19.8 the air velocity within the enclosure should provide an average minimum cross-draft or down-draft past each worker during abrasive blasting operations as follows:

3.10.5.19.8.1 cross draft capture velocity of 0.5 m/sec (100 ft./min) at the worker breathing zone.

3.10.5.19.8.2 Down draft capture velocity of 0.25 m/sec (50 ft./min) at the worker breathing zone.

3.10.5.20 If the enclosure is located outdoors these additional requirements should be met:

3.10.5.20.1 the enclosure should be made of windproof materials that are impermeable to dust.

3.10.5.20.2 the enclosure should be supported by a structure that prevents more than minor movement of the enclosure.

3.10.5.21 *Indoor Operations*

3.10.5.22 If abrasive blasting is being conducted indoors and persons other than those doing the abrasive blasting may be exposed to silica-containing dust, the abrasive blasting area should be separated from the rest of the project by an enclosure that will confine the dust within the abrasive blasting area.

3.10.5.23 When an indoor abrasive blasting operation is completed, dust and waste should be cleaned up and removed by vacuuming with a HEPA-filter-equipped vacuum, wet sweeping or wet shoveling.

3.10.5.24 *Outdoor Operations*

3.10.5.25 If abrasive blasting is being conducted outdoors and persons other than those doing the abrasive blasting may be exposed to silica-containing dust, the work area should be identified by ropes or barriers located at least 25 metres from the abrasive blasting area, to prevent entry by workers not directly involved in the operation.

3.10.5.26 If it is not possible to locate the ropes or barriers at least 25 metres from the abrasive blasting operation, the employer should ensure that the abrasive blasting area is separated from the rest of the project by an enclosure that will confine the dust within the abrasive blasting area

3.11 Vinyl Chloride Monomer

3.11.1 Vinyl chloride monomer would not be expected in the Work Area and was not noted during previous investigations.

3.11.2 Vinyl chloride monomer, however, is typically a component of Poly Vinyl Chloride (PVC) piping and conduits. If present on site, this form of vinyl chloride would not be expected to be a health & safety concern during routine demolition work.

End of Section

LIST OF CONTENTS

Page

1. GENERAL 2
1.1 General and Related Work 2
1.2 Outline of Work 2
1.3 Definitions 3
1.4 Reference Material and Regulations 3
1.5 Worker and Visitor Protection 4
1.6 Removal Contractor Qualifications 4
1.7 Disposal Contractor Qualifications 4
1.8 Waste Transport and Disposal 4

2. PRODUCTS 5
2.1 Materials and Equipment 5

3. EXECUTION 6
3.1 Identification 6
3.2 Removal of Luminaire Capacitors and Ballasts 6
3.3 Temporary Storage of PCB-Containing Equipment 6
3.4 Preparation for Disposal 7
3.5 Schedule of Possible PCB Containing Equipment 8
3.6 Schedule of PCB Identification Guide 8

1. GENERAL

1.1 General and Related Work

1.1.1 All sections of the specifications form a part of the Contract Document and shall be read to determine their effect upon the work of this section.

1.1.2 Related Work Specified Elsewhere

Division 2	Section 02 82 00	Abatement Scope and Details
Division 2	Section 02 82 01	Type 1 Asbestos Abatement
Division 2	Section 02 82 02	Type 2 Asbestos Abatement
Division 2	Section 02 82 04	Type 3 Asbestos Abatement
Division 2	Section 02 83 00	Lead Abatement
Division 2	Section 02 83 10	Other Hazardous Materials

Attachments:

1) *Pre-Renovation Designated Substances and Hazardous Materials Survey, Spadina House Museum – Stone Garage, 285 Spadina Road, Toronto, ON*, prepared by ECOH Management Inc., June 20, 2023.

1.1.3 The Contractor is responsible to verify all measurements for removal, cleaning, and re-insulation purposes. Measurements and quantities provided herein are for reference only.

1.1.4 It is the intent that abatement performed as per this section will result in the removal and disposal of all hazardous materials as well as any materials that may have been contaminated either during or prior to work of this Section.

1.1.5 This Section includes requirements for electrical capacitors and ballasts containing Polychlorinated Biphenyl (PCBs) liquids including; Identification, Removal, Preparation for disposal, Transportation, Temporary Storage, and Permanent Disposal.

1.1.6 Refer to Section 02 82 00, Abatement Scope and Details, for the following information and requirements;

1.1.6.1 Site Conditions,

1.1.6.2 Schedule,

1.1.6.3 Supervision,

1.1.6.4 Quality Assurance,

1.1.6.5 Regulations,

1.1.6.6 Notification, and

1.1.7 Submittals.

1.2 Outline of Work

1.2.1 Using safety precautions outlined in this section and accepted by the Environmental Consultant, the Contractor shall safely remove, handle and inspect all fluorescent light ballasts throughout the subject demolition area for the presence of PCBs.

1.2.2 Ballasts with unidentifiable serial codes, or from manufacturers who are not included in the standard PCB Identifier Code literature, or are not clearly marked as “PCB Free” or no date is clearly visible, must be assumed to contain PCBs.

1.2.3 The Contractor shall protect all surfaces, building fabric and items not affected by work of this project.

1.2.4 The Contractor shall replace or repair any items damaged during work of this project that will not be subject to demolition.

1.3 Definitions

1.3.1 Authorized Visitor(s): The Owner or his approved representative and/or persons representing regulatory agencies.

1.3.2 Competent Personnel: a worker who is qualified because of knowledge, training and experience to perform the work; is familiar with the Ontario Occupational Health and Safety Act and with the provisions of the regulations that apply to the work, and; has knowledge of all potential or actual danger to health or safety in the work.

1.3.3 Disposal: Means transportation to specified disposal facility for permanent disposal, or to an approved site for temporary storage and subsequent transportation to the specified permanent disposal facility.

1.3.4 Removal: Means detachment of PCB-containing capacitors and ballasts from applicable fixtures and includes preparation for disposal as described in this Section.

1.3.5 Work: Includes all services, labour and material required to complete the work as specified in the contract.

1.3.6 Work Area(s): Area(s) where work takes place that will, or may disturb hazardous materials.

1.4 Reference Material and Regulations

1.4.1 The Contractor Shall perform work in accordance with the recommendations in the following Environment Canada publications:

1.4.1.1 Handbook on PCBs in Electrical Equipment by Environment Canada.

1.4.1.2 Identification of Fluorescent Lamp Ballasts Containing PCBs, EPS 2/CG/2, April 1986, by Environment Canada.

1.4.2 The Contractor Shall comply with Federal, Provincial, and local requirements pertaining to hazardous waste removal and general demolition activities, provided that in any case of conflict among those requirements or with these specifications, the more stringent requirement shall apply. The regulations and guidelines shall include but not be limited to the following:

1.4.2.1 Government of Canada – Canadian Environmental Protection Act,

1.4.2.2 Government of Canada – Canadian Environmental Protection Act – Chlorobiphenyls Regulations,

1.4.2.3 Government of Canada – Transportation of Dangerous Goods Act and Regulations,

1.4.2.4 Government of Ontario – Dangerous Goods Transportation Act and Regulations,

1.4.2.5 Government of Ontario - Environmental Protection Act and Regulations,

1.4.2.6 Regulations for Construction Projects Ontario Regulation 213/91,

1.4.2.7 Office of the Fire Commissioner of Canada,

1.4.2.8 Electrical Safety Code,

1.4.2.9 WHMIS Regulations RRO 1990 Reg. 860,

1.4.2.10 Ontario Occupational Health and Safety Act RSO 1990 c0.1, as amended,

1.4.2.11 Other legislation and regulations that apply to the performance of the work of this section.

1.5 Worker and Visitor Protection

1.5.1 The Contractor shall require workers and visitors to wear PCB resistant gloves in addition to normal work clothing where exposure risk is low.

1.5.2 The Contractor shall provide workers and visitors with additional protective clothing and equipment where contact with liquid PCBs may occur.

1.5.3 The Contractor shall provide workers and visitors clothing and equipment appropriate for the potential level of exposure.

1.6 Removal Contractor Qualifications

1.6.1 Persons employed for the removal of capacitors and other energized electrical equipment shall be qualified electricians.

1.6.2 Where contact with liquid PCB is possible, personnel shall be instructed in handling procedures, safety precautions, use of safety equipment and applicable Federal and Provincial legislation and regulations.

1.7 Disposal Contractor Qualifications

1.7.1 Handling and transportation of hazardous wastes shall be performed by a company registered as a carrier with the Government of Ontario.

1.7.2 The Contractor shall submit proof that all persons involved in handling, packing, loading, transportation, unloading, unpacking and disposal of PCB waste are trained in accordance with the Dangerous Goods Transportation and Handling Act.

1.8 Waste Transport and Disposal

1.8.1 The Contractor shall transport waste PCBs in accordance with Federal and Provincial regulations.

1.8.2 The Contractor shall ensure that all materials are properly packaged and labelled prior to transportation.

1.8.3 The Contractor shall ensure PCB-containing equipment and PCB-contaminated materials, removed during the work are treated, packaged, transported and disposed of as PCB waste.

1.8.4 The Contractor shall ensure shipment of containers for disposal is taken by waste hauler licensed to transport PCB waste.

1.8.5 The Contractor shall transport hazardous waste materials in properly placarded vehicles equipped with a rainproof and windproof box.

1.8.6 Each load shall be accompanied by a properly completed Transportation of Dangerous Goods Regulation (TDGR) Waste Manifest. The Contractor shall provide the Owner with a copy of each waste manifest.

1.8.7 The Contractor shall arrange and pay for permanent disposal of PCBs and PCB contaminated material in an environmentally safe manner, at a registered PCB waste disposal site, in accordance with Federal and Provincial regulations.

1.8.8 The Contractor shall co-operate with Ministry of Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to Owner.

2. PRODUCTS

2.1 Materials and Equipment

2.1.1 Absorbent Material: PCB absorbent materials and/or products which will create a quasi-solid product which can be swept or shovelled include;

2.1.1.1 Sawdust,

2.1.1.2 Vermiculite,

2.1.1.3 Activated charcoal,

2.1.1.4 Oclansorb,

2.1.1.5 Inbiber Beads,

2.1.1.6 Hy-Dry,

2.1.1.7 Diasorb,

2.1.1.8 Stay-Dry,

2.1.1.9 Oil-Dry,

2.1.1.10 Conwed,

2.1.1.11 3-M matting, and

2.1.1.12 Graboil.

2.1.2 Disposal Drums: To CAN/CGSB-43.150-97, steel drum (1A2), 205 litre capacity, minimum 1.2 mm thick sheet steel, fitted with removable steel lids, with lid gaskets made of PCB resistant materials and meeting Transportation of Dangerous Goods Regulations and applicable Provincial requirements.

2.1.3 Plastic Bags: To CAN/CGSB-43.150-97, minimum 150-micrometer thick sheet polyethylene. Bag seams shall be sufficiently strong to resist pressure and shocks that occur under normal conditions of transport. Designed and manufactured to contain a maximum net mass of 50 kg.

2.1.4 Solvent: Following solvents are acceptable;

2.1.4.1 Varsol,

2.1.4.2 Kerosene,

2.1.4.3 Turpentine,

2.1.4.4 Number 1 fuel oil, and

2.1.4.5 1,1,1-trichloroethane.

3. EXECUTION

3.1 Identification

3.1.1 The Contractor shall inspect luminaries listed in the "Schedule of Possible PCB Containing Equipment" (section below) to identify capacitors and ballasts containing PCBs. Take care to accurately identify capacitors and ballasts as PCB type or non-PCB type.

3.2 Removal of Luminaire Capacitors and Ballasts

3.2.1 The Contractor shall remove all PCB containing capacitors and ballasts as follows:

3.2.1.1 Fluorescent Luminaires and HID Luminaires with Potted Ballasts: remove entire ballast, including capacitor.

3.2.1.2 HID Luminaires with Non-potted Ballasts: remove capacitor only. If capacitor is leaking also dispose of ballast.

3.2.2 The Contractor shall clean any black residue from luminaires using rags and solvent. Black residue may contain PCBs. The Contractor shall dispose of rags as PCB waste.

3.2.3 The Contractor shall dispose of non-PCB containing ballasts as construction waste.

3.3 Temporary Storage of PCB-Containing Equipment

3.3.1 Should temporary storage of PCB-containing equipment be required, the Contractor shall establish temporary storage facility as follows;

3.3.1.1 Construct on-site temporary storage facility within the project construction area.

3.3.1.2 The on-site temporary storage facility is to be of sufficient size for the intended use.

3.3.1.3 Signs are to be posted to indicate the presence of a temporary PCB storage facility.

3.3.1.4 Two layers of fibre-reinforced (rip-proof) polyethylene sheeting, each independently sealed, is to be installed on the floor surface and is to be extended a minimum of 2-inchs on perimeter walls and/or extended over temporary retention structures (i.e. 2 x 4 lumber).

3.3.1.5 Wood shipping pallets are to be placed on top of the layered polyethylene.

3.3.1.6 Two additional layers of rip-proof polyethylene sheeting are to be placed on the pallet. The sheeting is to be placed with sufficient excess to enclose materials to be placed on the pallet.

3.3.1.7 PCB-containing equipment are to be neatly stockpiled on the pallet.

3.3.1.8 All PCB-contaminated materials (including used personal protective equipment) are to be sealed within clear polyethylene bags and then placed on the pallet.

3.3.1.9 Once the capacity of the pallet has been reached, the excess rip-proof polyethylene sheeting is to be used to enclose the PCB-containing equipment and PCB-contaminated materials. The rip-proof polyethylene sheeting is to be sealed in a manner to prevent unintentional unravelling.

3.3.2 Inspections of the on-site temporary storage facility, including the area immediately below the pallet, is to be completed on a daily basis by the Contractor to ensure that integrity of the rip-proof polyethylene sheeting is maintained.

3.4 Preparation for Disposal

3.4.1 The Contractor shall place contaminated materials into plastic bags. Close bags securely using appropriate ties. The Contractor shall handle bags containing material in a manner to prevent bag puncture.

3.4.2 The Contractor shall place minimum 75 mm of absorbent material in bottom of drum.

3.4.3 The Contractor shall place capacitors into drum with terminals facing up.

3.4.4 The Contractor shall package PCB contaminated gloves, work clothes and rags in plastic bags and place in drums.

3.4.5 The Contractor shall seal drums and store in a designated storage area pending transportation and disposal.

3.4.6 The Contractor shall label drums containing liquid PCB, contaminated material and equipment, with a severe hazard labels.

3.4.7 Each container must be marked in accordance with the Dangerous Goods Transportation and Handling Act, showing the shipping name (polychlorinated biphenyl), the product identification number (UN2315) and a Class 9 label by the Contractor.

3.5 Schedule of Possible PCB Containing Equipment

3.5.1 Fluorescent light ballasts and capacitors throughout the specified work area may contain PCBs. The Contractor shall inspect items to confirm the presence or absence of PCB. Remove items where the absence of PCBs cannot be confirmed from equipment and dispose of as PCB waste.

3.5.2 Abbreviations:

MC	Motor Capacitor
FFB	Fluorescent Fixture Ballast
HID-C	High Intensity Discharge Luminaire-Capacitor
HID-PH	High Intensity Discharge Luminaire-Potted Ballast

3.6 Schedule of PCB Identification Guide

3.6.1 The following schedule provides a guide to identify ballasts containing PCBs. Other ballasts should be considered to contain PCBs if they were manufactured prior to July 01, 1980, or if the absence of PCBs cannot be confirmed.

3.6.2 Table 1: PCB Identification Guide

Manufacturer	Code Interpretation
Aerovox Incorporated Canada	Codes are located on labels attached to capacitors. Two Possibilities; 1) Four number code on capacitor label. The first two numbers are the year and the last two are the month (e.g. January 1980 = 8001). PCBs **are** present up to and including June 1978 (7806). 2) Six-digit letter and number code stamped on capacitor. PCBs **are** present if the fifth digit is "F".
Advanced Ballasts (supplied by Philips)	Three or four digit number code on the ballast cover. The first one or two numbers indicate the month and the last two numbers are the year. PCBs **are** present up to and including 1978 (e.g. 1278 or lower)
Allanson Division of Jannock Ltd.	Two letter code stamped on ballast nameplate located on the end of ballasts. The first letter is the month, starting with "A" for January and the second letter is the year, starting with "A" for 1969 (e.g. February 1972 = BD). PCBs **are** present up to and including December 1980 (LL).

Manufacturer	Code Interpretation
Canadian General Electric	Codes are located on nameplates attached to ballasts. Date codes are stamped on nameplates or on reverse side of ballast housing. Two Possibilities; 1) Seven letter and number digit code on ballast name plate. PCBs **are not** present if one of the two final letters is "E" and *likely present* if it is "T". 2) Four number code on ballast housing. The first two numbers, when reversed, are the year (e.g., 1976 = 67) and the last two numbers are the month. PCBs **are** present up to and including March 1978 (8703).
Westinghouse Canada	Same as for Canadian General Electric (above).
Magnatex Polygon	Letter and number code on the ballast. The last four numbers represent the year and the month. PCBs **may** be present up to and including June 1980 (June 1980 = 8006). PCBs **are** present in capacitors made in 1978-79 unless there is a green "NO PCB" sticker on the ballast label.
Magnatex Universal Manufacturing (USA)	Three digit letter and number code on ballast cover. The first letter is the month (A = January) and the last two numbers are the year. PCBs **are** present up to and including December 1978 (L78). PCBs **are not** present if "N" follows the code.
Phillips Electronics	Date codes are stamped onto ballast housings, on a tab on the side, or on the side facing the ceiling. Coding system changed in 1980. Units made after early 1979 are marked as being free of PCBs. Treat units as **PCB containing** if not marked "PCB Free" or if having a digit code ending with 79 or earlier.
Sola Canada	Three digit letter and number code on ballast label. The first letter is the month (A = January) and the last two numbers are the year. PCBs **are** present up to and including December 1979 (L79).
Sola Electric (USA)	Eight digit letter and number code on ballast nameplate. The first two numbers are the year. Assume PCBs **are** present up to and including December 1979.
Other Manufacturers	Assume PCBs **are** present if the unit is not marked "PCB Free" or not clearly dated 1980 or later.

Manufacturer	Code Interpretation
High Intensity Discharge Lamps	*Allanson Division of Jannock Ltd*. Puts "N" before the code if PCBs **are not** present. Others are usually marked "PCB" or "NO PCB". Assume PCBs **are** present if the label is not marked otherwise. *Holophane Canada Inc.* puts "BAA" before its three-digit code number on capacitors where PCBs **are** present. *Sola Canada* marks capacitors where PCBs **are** present with a code beginning "ACA".

3.6.3 Identification may require disassembly of fluorescent lamp ballasts or other lighting systems such as High Intensity Discharge (HID) systems that are open to view.

End of Section

PRE-RENOVATION DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY

SPADINA HOUSE MUSEUM – STONE GARAGE
285 SPADINA ROAD
TORONTO, ON

Prepared for:
City of Toronto
Corporate Real Estate Management
55 John Street, 2nd Floor
Toronto, ON M5V 3C6
Attention: Sara Reid

Prepared by:

ECOH
75 Courtneypark Drive West, Unit 1
Mississauga, ON L5W 0E3

ECOH Project No.: **26974**
June 20, 2023 **(Updated)**

EXECUTIVE SUMMARY

ECOH Management Inc. (ECOH) was retained by the City of Toronto to conduct a Pre-Renovation Designated Substances and Hazardous Materials assessment at the Spadina House Museum - Stone Garage, located at 285 Spadina Road in Toronto, ON. The objectives of the survey were to identify potential environmental considerations associated with future renovations to the Stone Garage, hereafter referred to as the "Project Area", and provide recommendations, as necessary, to fulfil requirements set forth within the Ministry of Labour Codes as well as the Ontario Occupational Health and Safety Act. Ms. Naomi Pitcher of ECOH performed the survey and assessment on February 9, 2022.

This executive summary provides a brief overview of the key survey findings and associated recommendations. Detailed information regarding the findings and recommendations are discussed in the body of the report.

FINDINGS

Table 1 presents a brief outline of ECOH's findings within the Project Area. For analytical results for asbestos, refer to Appendix I - Results of Bulk Sample Analysis for Asbestos & Lead. Refer to the main body of the report and Appendices II and III for specific details, quantities and locations of Designated Substances and Hazardous Materials in the Project Area.

Table 1: Summary of Findings

Material	Findings
Asbestos	Asbestos-containing materials (ACM) are present in various locations throughout the Project Area in the following forms: • Plaster on Ceilings (**1% Chrysotile**) o Throughout Project Area • Parging Cement on Boiler 1 (**50-75% Chrysotile**) o Basement (Location B-01) • Interior boiler materials (Boiler 1) are **assumed to be asbestos-containing** • Hard black caulking around boiler joint (**1% Chrysotile**) o Basement (Location B-01) • Vinyl Floor Tiles 2 – 12"x 12" Brown with white streaks (**3% Chrysotile**) o Stairwell Entrance (Location 1-01) • Vinyl Sheet Flooring 07 - Beige with diamond pattern (**25% Chrysotile)** o Second Floor Washroom (Location 2-03) • Soft black window caulking (**4% Chrysotile**) o Building Exterior (Location 0-00)

Table 1: Summary of Findings	
Material	**Findings**
	Additional asbestos-containing materials may be present within concealed conditions of the Project Area (i.e., above fixed ceilings, within wall cavities, pipe chases, etc.).
Lead	The following lead-based paints (i.e., concentrations of lead equal to or greater than 0.5% by weight, or 5000 parts per million (ppm), were identified during this assessment: • **Off-White Paint on Walls, Trim and Doors** – throughout the Project Area **(96,000 ppm)**, • **Brown Paint on Trim** - throughout the first floor **(14,000 ppm)** The following lead-containing paints (i.e., concentrations of lead equal to or greater than 0.1% by weight, or 1000 parts per million (ppm), were identified during this assessment: • **Green Paint on Wall** - Basement Stairwell **(3,200 ppm)** All other paints sampled as part of this assessment were non-lead-based, however, all paints are assumed to contain varying percentages or trace amounts of lead. No other major sources of lead or lead-containing products were identified during the survey; however, lead may be present in: • Internal batteries associated with emergency lighting system, • Ceramic tile glazing, • Wiring connectors and electric cable sheathing, and • Solder joints on copper piping.
Mould	Mould-growth was not observed to be present at the time of the assessment.
Mercury	Thermostats throughout the Project Area contain mercury liquid. Minor quantities are also present as a vapour within fluorescent tubes lights and as a possible constituent of paints and adhesives.
Polychlorinated Biphenyls (PCBs)	May be present in light ballasts throughout the Project Area.
Silica	Present in all concrete and masonry products.

Table 1: Summary of Findings	
Material	**Findings**
Other Designated Substances and Hazardous Materials	Acrylonitrile, Arsenic, Benzene, Coke Oven Emissions, Ethylene Oxide, Mould, Ozone Depleting Substances, Isocyanates, Urea Formaldehyde Foam Insulation (UFFI) and Vinyl Chloride Monomer were not noted in significant quantities or forms, if at all.

RECOMMENDATIONS

The following recommendations meet the requirements of the Occupational Health and Safety Act. Asbestos recommendations meet the requirements of the Designated Substance – Regulation respecting *Asbestos on Construction Projects and in Buildings and Repair Operations*, Ontario Regulation 278/05. Based upon review of historical reports, as well as analytical results and observations of this assessment, ECOH offers the following for your consideration.

Asbestos

Based on survey results, the following conclusions are made with regards to asbestos-containing materials (ACMs) within the Project Area:

- As asbestos-containing materials (ACM) are present with the Project Area, ECOH recommends that all workers have asbestos awareness and respirator training before commencing work. Asbestos awareness training will provide on-site workers; the understanding of asbestos-related health and safety issues; the ability to recognize ACM and any situation that may present a potential asbestos exposure, and the ability to respond appropriately to an inadvertent disturbance of ACM in the work area.
- Prior to removal or disturbance, if required, boilers/boiler interiors should be tested for asbestos-content. Alternatively, these materials can be assumed to contain asbestos, and the appropriate level of asbestos safety precautions must be implemented.
- Removal or disturbance of friable ACM (i.e., vinyl sheet flooring, parging cement, plaster) must employ Type 3 Asbestos Safety Precautions for the removal of more than one square meter of material.
- Removal or disturbance of friable ACM (i.e., vinyl sheet flooring, parging cement, plaster) must employ Type 2 asbestos safety precautions, at a minimum, for the removal of less than one square meter of material.
- Removal or disturbance of non-friable ACM (i.e., vinyl floor tiles, caulking) must employ Type 1 Asbestos Safety Precautions, at a minimum, if the material is wetted to control the spread of dust and the work is completed using non-powered hand-held tools.
- Any demolition, renovation or maintenance activities involving materials found NOT to contain asbestos, or not suspected of containing asbestos, should implement general health

and safety precautions including, in part, the use of dust suppression techniques and appropriate respiratory protection.

- The asbestos-related findings of this report and any required removal of identified ACM should be used to update information within, or be inserted into, the facility's inventory of asbestos-containing building materials.
- During project work, if any additional materials are found beyond those which are described in this report or described in the existing inventory of asbestos-containing materials (i.e. materials not previously identified, or materials that are not homogenous to those previously identified, or materials that become revealed during the work), additional testing for asbestos-content should be completed immediately and prior to disturbance of the material. Alternatively, these materials can be assumed to contain asbestos, and the appropriate level of asbestos safety precautions must be implemented.
- Prior to renovation work, confirmed asbestos-containing materials that have the potential to be disturbed during the renovation work must be removed using asbestos safety procedures detailed within Ontario Regulation 278/05. Classification of the asbestos operation should be determined by an experienced and qualified person.

Lead

The removal of assumed or confirmed lead-containing construction materials (i.e., lead concentrations >0.1% or 1000ppm) should be completed in accordance with the recommendations of the Environmental Abatement Council of Canada (EACC), *EACC Lead Guideline for Construction, Renovation, Maintenance or Repair*, October 2014, which incorporates the Ontario Ministry of Labour Document, *Guideline Lead on Construction Projects*, April 2011.

Materials containing even trace amounts of lead should be removed without grinding, cutting, torching, or chemical stripping. Additionally, workers should employ general safety precautions such as appropriate dust suppression methods and proper personal protective equipment.

Mercury

The presence of mercury within wall-mounted thermostats, fluorescent tubes lights, paints and adhesives should not be considered a hazard provided the assembled units remain sealed and intact. Avoid direct skin contact with mercury and avoid inhalation of mercury vapour. Dispose of mercury following requirements of the Canada Environmental Protection Act, the Transportation of Dangerous Goods Act and provincial legislative requirements that may be applicable.

Silica

Cutting, grinding, or demolition of materials containing silica should be completed using general health and safety precautions including the use of dust suppression techniques and appropriate respiratory protection.

During major renovations, removal of materials containing silica should be removed following recommendations detailed within the Ministry of Labour document, *Guideline - Silica on Construction Projects*, dated, April 2011.

Polychlorinated Biphenyls (PCBs)

Fluorescent light ballasts should be removed and disassembled to observe serial codes which should be compared to standard PCB Identify Code literature. Ballasts with unidentifiable serial codes, or from manufacturers who are not included in the standard PCB Identifier Code literature or are not clearly labelled as “PCB Free”, or no date is clearly visible (ballasts dated 1981 or later do not contain PCBs), must be assumed to contain PCBs. Ballasts confirmed or assumed to contain PCBs must be disposed of following applicable legislative requirements (e.g., Canada Environmental Protection Act, the Transportation of Dangerous Goods Act and provincial legislative requirements as may be applicable).

This executive summary provides a brief overview of the study findings. It is not intended to substitute for reading the complete report, nor does it discuss specific issues documented in the report.

TABLE OF CONTENTS

EXECUTIVE SUMMARY……i

1. INTRODUCTIONS..... 1

1.1 Building Description..... 1

1.2 Regulatory Requirements..... 1

2. SURVEY SCOPE OF WORK AND METHODOLOGY 2

2.1 General Approach..... 2

2.2 Records Review..... 2

2.3 Survey Drawings..... 3

2.4 Asbestos Survey Methodology..... 3

2.5 Analysis of Lead in Paint..... 5

2.6 Mould Assessment..... 5

2.7 Survey of Other Hazardous Materials..... 5

3. FINDINGS..... 6

3.1 Asbestos..... 6

3.2 Lead..... 11

3.3 Mercury..... 12

3.4 Silica..... 12

3.5 Mould..... 12

3.6 Ozone Depleting Substances (ODS)..... 13

3.7 Polychlorinated Biphenyls (PCBs)..... 13

3.8 Other Designated Substances and Hazardous Materials..... 13

4. CONCLUSIONS AND RECOMMENDATIONS 13

4.1 Asbestos..... 13

4.2 Lead..... 14

4.3 Mercury..... 14

4.4 Mould..... 15

4.5 Silica..... 15

4.6 Polychlorinated Biphenyls (PCBs)..... 15

5. STATEMENT OF LIMITATIONS..... 15

6. CLOSURE..... 16

APPENDICES

Appendix I: Hazardous Materials Inventory Sheet

Appendix II: Results of Bulk Sample Analysis for Asbestos & Lead

Appendix III: Survey Drawings (“Area of Investigation”)

Appendix IV: Site Photographs

1. INTRODUCTIONS

ECOH Management Inc. (ECOH) was retained by the City of Toronto to conduct a Pre-Renovation Designated Substances and Hazardous Materials assessment at the Spadina House Museum - Stone Garage, located at 285 Spadina Road in Toronto, ON. The objectives of the survey were to identify potential environmental considerations associated with future renovations to the Stone Garage, hereafter referred to as the "Project Area", and provide recommendations, as necessary, to fulfil requirements set forth within the Ministry of Labour Codes as well as the Ontario Occupational Health and Safety Act. Ms. Naomi Pitcher of ECOH performed the survey and assessment on February 9, 2022.

The survey included an investigation for the presence of Designated Substances including:

- Acrylonitrile
- Arsenic
- Asbestos
- Benzene
- Coke Oven Emissions
- Ethylene Oxide
- Isocyanates
- Lead
- Mercury
- Silica
- Vinyl Chloride Monomer

And for Hazardous Materials including:

- Polychlorinated Biphenyls (PCB)s
- Mould
- Ozone Depleting Substances (ODS)
- Other Hazardous Materials

The following report details the project scope of work, regulatory requirements, survey and analytical methodologies, survey findings and recommendations, and survey statement of limitations.

1.1 Building Description

The subject building, located at 285 Spadina Road, Toronto, ON is known as the Stone Garage, an outbuilding of the Spadina House Museum. The building is a two (2) storey stone structure with unfinished basement. An enclosed garage comprises much of the first floor and remaining spaces on the first and second floor are used as offices and staff kitchens.

1.2 Regulatory Requirements

A Designated Substances and Hazardous Materials Report is completed to fulfil the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act. Prior to tendering project work in a building, the building owner must provide this report to contractors tendering on the work.

Ministry of Labour Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, controls the disturbance of asbestos materials on construction projects. Ministry of Environment Regulation, R.R.O. 347, controls the disposal of asbestos waste. The Ministry of Labour has also issued guidelines for the control of Lead and

Silica on construction projects, these entitled, *Guideline - Lead on Construction Projects* and *Guideline - Silica on Construction Projects*.

There are no specific Ministry of Labour regulations for control of the remaining Designated Substances on construction projects. However, the Ministry of Labour actively enforces the general duty clause of the Occupational Health and Safety Act which protects workers and provides guidance on exposure monitoring, permissible exposure levels, medical monitoring, etc., for all Designated Substances in an occupational setting.

2. SURVEY SCOPE OF WORK AND METHODOLOGY

2.1 General Approach

Details of the survey methodology, as was applied to this facility, are as follows:

- To ensure familiarity with the facility, the surveyor referred to project drawings provided by City of Toronto.
- Visual inspections of the Project Area (as denoted on the project drawings) were completed using the following protocol:
  - Common areas and rooms such as corridors, lobbies, washrooms, etc.
  - All Accessible areas (i.e., above false ceilings or within solid ceilings and walls where access hatches were available)
  - The survey did not include demolition of building systems or finishes to visually assess concealed conditions.
- Reporting the findings of visual inspections is completed using the following protocol:
  - Details of specific observations are reported for each room in which observations were collected during visual inspections.
  - Details of specific observations collected from visual inspections of the representative number of units/locations were used to extrapolate information for adjacent areas or areas of similar design.

2.2 Records Review

As part of this survey, ECOH reviewed the following reports and certificates of analysis:

- *Spadina Museum Garage Restoration and Site Accessibility, 285 Spadina Road, Toronto, ON, M5R 2V5, Issued for 100% Design Development,* prepared for the City of Toronto by Stevens Burgess Architects Ltd., dated April 26, 2023 (File No: A22048 / File Name: Arch – 100% DD).
- *Spadina Museum Garage Restoration and Site Accessibility, 285 Spadina Road, Toronto, ON, M5R 2V5, Issued for 100% Design Development,* prepared for the City of Toronto by

Mat 4Site Engineers Ltd., dated April 26, 2023 (Project No: 22626 / File Name: M&E – 100% DD).

- *Spadina Museum Garage Rehabilitation, 285 Spadina Road, Toronto, ON, Issued for 100% Design Review,* prepared for the City of Toronto by Stevens Burgess Architects Ltd., dated April 26, 2023 (Project No: TE-41243-22 / File Name: Structural – 100% DD).
- *Survey for Designated Substances and Hazardous Materials, Spadina House Museum, 285 Spadina Road, Toronto, Ontario,* prepared for the City of Toronto by ECOH Management Inc., dated November 27, 2020.
- *Designated Substance Sampling Report, Spadina House Garage, 285 Spadina Road, Toronto, ON,* prepared for the City of Toronto by Fisher Environmental Ltd., dated April 28, 2020.
- *Bulk Asbestos Analysis, 91828.137, City of Toronto, Spadina House Museum; 285 Spadina Road, Toronto,* submitted by Pinchin Environmental Ltd., date of analysis May 9, 2014.
- *Pinchin Environmental Asbestos Laboratory Certificate of Analysis,* date of analysis June 9, 2009.

2.3 Survey Drawings

Locations of Designated Substances and Hazardous Materials identified within the Project Area during the survey are illustrated on drawings (to the extent that is practicable) presented in Appendix II - Survey Drawings (“Area of Investigation”). Asbestos-containing materials (ACM) are denoted to be either “confirmed” or “assumed” to be present. Assumptions were made based on ECOH’s visual observations from similar or adjacent locations throughout the Project Area and understanding of typical building systems. This information was extrapolated and applied to locations that were not specifically investigated as part of this assessment.

2.4 Asbestos Survey Methodology

2.4.1 Asbestos Survey Omissions from Scope

When conducting an asbestos survey, it is standard practice to assume that certain building materials potentially contain asbestos. Depending on the material, this assumption is undertaken for one or more of the following reasons:

1. The material is inaccessible (i.e., underground piping).
2. There is an inherent danger in sampling the material (i.e., high voltage wires).
3. Sampling will compromise the integrity of the building structure or envelope (i.e., roofing felts).

Therefore, for the purpose of this survey, ECOH assumed the following materials (if present) are asbestos-containing:

- Fire doors
- High voltage wiring
- Mechanical packing and gaskets
- Underground services or piping

In addition, no identification was made of asbestos products used in manufacturing processes or operations (i.e., manufacturing equipment, laboratories, etc.).

2.4.2 Asbestos Sampling Strategy and Analytical Methods

Bulk samples of potential asbestos-containing materials were collected for analysis during the survey. As per the requirements of Ontario Regulation 278/05, multiple samples (ranging from 1 to 7 depending on quantity and type of material) are required to confirm the absence of asbestos. Only one positive result (i.e., confirming the presence of asbestos) is required to classify a material as asbestos-containing. Therefore, ECOH's sampling strategy involves the collection of sufficient numbers of samples to meet regulatory requirements, followed by instructions to the laboratory to cease analysis when one sample within a series has already proven positive for asbestos. Sampling required a small volume of material to be removed either from a damaged section of suspect material or cut from intact material and then repaired by sealing with tape to prevent fibre release. The collected samples were placed in plastic bags and sealed during shipment to an independent laboratory. A formal chain of custody procedure was maintained between ECOH and the sub-contract laboratory during sample transport. Samples were then analyzed following the analytical procedure prescribed by the Regulation 278/05, U.S. Environmental Protection Agency Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials. June 1993. Although not required by provincial regulation, all laboratories used by ECOH are accredited under the U.S. National Voluntary Laboratory Accreditation Program (NVLAP) to ensure consistent, accurate and defendable results.

Where possible, ECOH has used existing analytical data, rather than collect and analyze additional bulk samples. Although historical sample information is used to confirm the presence of asbestos in suspect materials, historical samples are not used in defining materials as non-asbestos. Historical sample results were only used if the surveyor, based on his/her experience, could clearly associate the sample information with the material present at the Site.

The collection of samples was performed with sufficient frequency to obtain a general pattern of asbestos use within the building. Due to building renovations or modifications that may have occurred in the past, the consistency of the application of asbestos materials may not be uniform throughout the entire facility. It is important to note that without sampling every wall, pipe section, ceiling tile, etc., it is not possible to identify the asbestos content in every material present in the building. For this reason, similar materials to those already sampled elsewhere in the building were visually identified as being the same as those samples without additional analysis.

The Chain of Custody and the Certificate of Analysis, which details analytical results referenced in the findings section, for all bulk sampling is presented within Appendix I - Results of Bulk Sample Analysis for Asbestos & Lead

The recommendations in this report take into consideration the condition and accessibility of the asbestos material as well as other factors such as water damage, vibration, air movement and general activities in the area.

Where ACM is found to be in GOOD condition and not likely to deteriorate or fall, the general recommendation is to re-evaluate the condition of the material on an annual basis. This recommendation is subject to change if the material is located in a manner that persons untrained in asbestos awareness could physically damage it.

Where the ACM is found to be damaged, a recommendation to have the material repaired, removed, encased, or encapsulated is offered. The recommendation will also indicate which asbestos safety precautions (i.e., Type 1, Type 2 or Type 3) should be undertaken when performing the remedial work.

2.5 Analysis of Lead in Paint

The presence of lead-in-paint was assessed by the collection and submission of bulk material samples to a professional laboratory for analysis by atomic absorption spectroscopy. Lead bulk samples that are collected are placed in plastic bags, sealed, and shipped to an independent laboratory. A formal chain of custody procedure is maintained between ECOH and the sub-contracted laboratory during sample transport. All laboratories used by ECOH are accredited under the U.S. EPA National Environmental Lead Laboratory Accreditation Program (NLLAP) and/or American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP) to ensure consistent, accurate and defensible results.

For the laboratory chain of custody and the certificate of analysis, which detail analytical results for all bulk samples referenced in the Findings Sections, refer to Appendix I - Results of Bulk Sample Analysis for Asbestos & Lead.

2.6 Mould Assessment

A visual mould assessment of the facility was carried out during this survey and included visual assessment and sampling, if required, but did not include intrusive investigation (i.e., test-cuts).

2.7 Survey of Other Hazardous Materials

Materials suspected of containing Designated Substances and Hazardous Materials, other than lead in paint or asbestos, were identified by appearance, age, and knowledge of historic applications in building construction and equipment design.

3. FINDINGS

3.1 Asbestos

The following is a brief discussion of the extent to which asbestos-containing materials (ACM) were identified in the Project Area. The discussion is organized under the headings of materials that are generally suspected of containing asbestos. Please refer to Table 2 for sample details and laboratory analysis results.

Table 2: Summary of Analysis of Asbestos Bulk Samples

Sample Number	Sample Location	Sample Description	Results
26974-ASB-01A	Basement Stairwell (Loc. B-01)	Plaster - Wall (Skim Coat)	None Detected
		Plaster - Wall (Rough Coat Coat)	None Detected
26974-ASB-01B	Stairwell Entrance (Loc. 1-01)	Plaster - Wall (Skim Coat)	None Detected
		Plaster - Wall (Rough Coat Coat)	None Detected
26974-ASB-01C	Storage Room (Loc. 1-04)	Plaster - Wall (Skim Coat)	None Detected
		Plaster - Wall (Rough Coat Coat)	None Detected
26974-ASB-01D	Washroom (Loc. 2-03)	Plaster - Wall	None Detected
26974-ASB-01E	Office (Loc. 2-06)	Plaster - Wall (Skim Coat)	None Detected
		Plaster - Wall (Rough Coat Coat)	None Detected
26974-ASB-02A	Office (Loc. 1-02)	**Plaster - Ceiling (Joint Compound)**	**2% Chrysotile**
		Plaster - Ceiling (Rough Coat)	None Detected
26974-ASB-02B	Office (Loc. 1-02)	**Plaster - Ceiling (Joint Compound)**	**Positive Stop (Not Analyzed)**
		Plaster - Ceiling (Rough Coat)	None Detected
26974-ASB-02C	Office (Loc. 2-05)	**Plaster - Ceiling (Joint Compound)**	**Positive Stop (Not Analyzed)**
		Plaster - Ceiling (Skim Coat)	None Detected
26974-ASB-02D	Corridor (Loc. 2-07)	**Plaster - Ceiling (Joint Compound)**	**Positive Stop (Not Analyzed)**
		Plaster - Ceiling (Rough Coat)	None Detected

Table 2: Summary of Analysis of Asbestos Bulk Samples			
Sample Number	**Sample Location**	**Sample Description**	**Results**
26974-ASB-02E	Corridor (Loc. 2-07)	**Plaster - Ceiling (Joint Compound)**	**Positive Stop (Not Analyzed)**
		Plaster - Ceiling (Rough Coat)	None Detected
26974-ASB-03A	Washroom (Loc. 1-06)	Drywall Joint Compound - Wall	None Detected
26974-ASB-03B	Washroom (Loc. 1-06)	Drywall Joint Compound - Wall	None Detected
26974-ASB-03C	Washroom (Loc. 1-06)	Drywall Joint Compound - Wall	None Detected
26974-ASB-04A	Office (Loc. 2-04)	Drywall Joint Compound - Ceiling	None Detected
26974-ASB-04B	Office (Loc. 2-04)	Drywall Joint Compound - Ceiling	None Detected
26974-ASB-04C	Office (Loc. 2-05)	Drywall Joint Compound - Ceiling	None Detected
26974-ASB-04D	Sewing Room (Loc. 2-06)	Drywall Joint Compound - Ceiling	None Detected
26974-ASB-04E	Corridor (Loc. 2-07)	Drywall Joint Compound - Ceiling	None Detected
26974-ASB-05A	Basement (Loc. B-01)	**Hard Black Caulking around Boiler Joint**	**1% Chrysotile**
26974-ASB-05B	Basement (Loc. B-01)	**Hard Black Caulking around Boiler Joint**	**Positive Stop (Not Analyzed)**
26974-ASB-05C	Basement (Loc. B-01)	**Hard Black Caulking around Boiler Joint**	**Positive Stop (Not Analyzed)**
26974-ASB-06A	Office (Loc. 2-05)	Black Carpet Mastic	None Detected
26974-ASB-06B	Office (Loc. 2-05)	Black Carpet Mastic	None Detected
26974-ASB-06C	Office (Loc. 2-05)	Black Carpet Mastic	None Detected
26974-ASB-07A	Garage (Loc. 1-05)	Rough Cast Cladding (Stucco) - Wall	None Detected
26974-ASB-07B	Garage (Loc. 1-05)	Rough Cast Cladding (Stucco) - Wall	None Detected
26974-ASB-07C	Garage (Loc. 1-05)	Rough Cast Cladding (Stucco) - Wall	None Detected
26974-ASB-08A	Building Exterior	Stone Mortar	None Detected
26974-ASB-08B	Building Exterior	Stone Mortar	None Detected
26974-ASB-08C	Building Exterior	Stone Mortar	None Detected

Table 2: Summary of Analysis of Asbestos Bulk Samples			
Sample Number	**Sample Location**	**Sample Description**	**Results**
26974-ASB-09A	Building Exterior	**Soft Black Exterior Window Caulking**	**None Detected**
26974-ASB-09B	Building Exterior	**Soft Black Exterior Window Caulking**	**None Detected**
26974-ASB-09C	Building Exterior	**Soft Black Exterior Window Caulking**	**4% Chrysotile**
26974-ASB-10A	Building Exterior	White Window Caulking	None Detected
26974-ASB-10B	Building Exterior	White Window Caulking	None Detected
26974-ASB-10C	Building Exterior	White Window Caulking	None Detected
	- shading indicates sample result positive for asbestos (if applicable)		

The locations and quantities of materials assumed or confirmed to be asbestos-containing can be found in the hazardous materials inventory sheet, which is included as Appendix I.

3.1.1 Spray Applied Fireproofing or Thermal Insulation (Friable)

Spray applied fireproofing was not observed within the Project Area at the time of the assessment.

3.1.2 Texture Finishes (Friable)

Texture finishes were not observed on walls or ceilings within the Project Area.

3.1.3 Thermal Mechanical Insulation (Friable)

Various **asbestos-containing** and non-asbestos mechanical insulations are present throughout the facility. The following presents a brief description of the mechanical insulations and the systems to which they are applied. Thermal mechanical insulation may be present within concealed conditions of the Project Area (i.e., above fixed ceilings, within wall cavities, pipe chases, etc.) and may not be denoted on Survey Drawings included as Appendix II.

3.1.3.1 Piping Systems

Pipe fittings (which may include elbows, valves, tees, hangers, etc.) observed throughout the building are insulated with non-asbestos materials (e.g., horsehair, foam, etc.), or not insulated.

Straight sections of pipe observed throughout the Project Area were observed to be not insulated or insulated with non-asbestos materials (e.g., horsehair, foam, etc.).

3.1.3.2 Duct Systems

Ducts observed throughout the Project Area are insulated with non-asbestos fiberglass or are uninsulated.

3.1.3.3 Mechanical Equipment

One (1) boiler unit (#1) within the basement was observed to be insulated with parging cement. This material has previously been sampled and laboratory analysis determined this material to **contain 50-75% Chrysotile asbestos**. This material was observed to be in POOR condition at the time of the assessment.

Boiler (#2) was observed to be hot at the time of the assessment, therefore access to the interior of the boiler was not possible. Materials within the boiler should be **assumed to contain asbestos** until sampling can determine asbestos content.

3.1.4 Asbestos Cement Products (Non-Friable)

Asbestos cement products were not observed during this assessment within the Project Area**.**

3.1.5 Acoustic Ceiling Tiles (Friable)

Acoustic ceiling tiles were not observed during this assessment within the Project Area**.**

3.1.6 Vinyl Floor Tiles (Non-Friable)

Vinyl Floor Tile - 12”x12” Brown with White Streaks were observed within the Project Area during this assessment. This material has previously been sampled and laboratory analysis determined this material to **contain 3% Chrysotile asbestos.** Associated mastic was determined to be non-asbestos containing.

3.1.7 Vinyl Sheet Flooring (Potentially-Friable)

Three (3) visually distinct types of vinyl sheet flooring (VSF) were observed within the Project Area during this assessment:

- VSF05 - Brown beige white block pattern. This material has previously been sampled and laboratory analysis determined this material to be non-asbestos.
- VSF06 - Brown with 2” square pattern. This material has previously been sampled and laboratory analysis determined this material to be non-asbestos. Associated mastic was also determined to be non-asbestos.
- VSF07 - Beige with diamond pattern. This material has previously been sampled and laboratory analysis determined this material to **contain 25% Chrysotile asbestos**.

3.1.8 Drywall Joint Compound (DJC) (Non-Friable)

Drywall joint compound was observed to be present primarily on drywall ceilings in the second floor of the Project Area. A small amount of drywall joint compound was also observed as patches on the walls of the first floor washroom. The following drywall joint compound samples were collected:

- Three (3) samples of drywall joint compound on walls were collected from the wall of the first-floor washroom (Loc. 1-06) (26974-03A-C), and laboratory analysis determined this material to be non-asbestos.
- Five (5) samples of drywall joint compound on ceilings were collected in representative locations throughout the Project Area (26974-04A-E), and laboratory analysis determined this material to be non-asbestos.

3.1.9 Plaster (Non-Friable)

Plaster was observed to be present on walls and ceilings throughout the Project Area.

- Five (5) samples of plaster on walls were collected in representative locations throughout the Project Area (26974-01A-E), and laboratory analysis determined this material to be non-asbestos.
- Five (5) samples of plaster on ceilings were collected in representative locations throughout the Project Area (26974-02A-E), and laboratory analysis determined this material to **contain 1% Chrysotile asbestos**.

3.1.10 Firestop (Non-Friable)

Firestop was not observed during this assessment within the Project Area.

3.1.11 Roofing Materials (Non-Friable)

The roof areas were not included within the scope of this project and therefore not sampled. Sampling of roofing materials should be completed prior to replacement or demolition of the building. Roofing materials are **assumed** to be ACM until sampling proves otherwise.

3.1.12 Caulking (Non-Friable)

Three (3) visually distinct types of caulking were observed within the Project Area at the time of the assessment.

- Hard black caulking around a joint on the basement boiler. Three (3) samples of this material were collected (26974-ASB-05A-C), and laboratory analysis determined this material to **contain 1% Chrysotile asbestos**.
- Soft black caulking around exterior window frames. Three (3) samples of this material were collected (26974-ASB-09A-C), and laboratory analysis determined this material to **contain 4% Chrysotile asbestos**.
- White caulking within exterior stone/wood joints. Three (3) samples of this material were collected (26974-ASB-10A-C), and laboratory analysis determined this material to be non-asbestos.

3.1.13 Mortar (Non-Friable)

Mortar was observed between stones on the building exterior. Three (3) representative samples of this material were collected (26974-ASB-08A-C), and laboratory analysis determined this material to be non-asbestos.

3.1.14 Other (Non-Friable)

Rough cast cladding (stucco) was observed on the walls and ceilings within the Garage (Loc. 1 05). Three (3) representative samples of this material were collected (26974-ASB-07A-C), and laboratory analysis determined this material to be non-asbestos.

Black mastic was observed beneath carpet and foam underlay throughout the second floor. Three (3) representative samples of this material were collected (26974-ASB-06A-C), and laboratory analysis determined this material to be non-asbestos.

3.2 Lead

Although no regulations exist in Ontario, guidelines indicate that paints and surface coatings that contain 0.5% lead concentration by dry weight (i.e. concentrations of lead at or above 0.5%, or 5000 parts per million (ppm), is considered to be a "lead-based paint or surface coating".

Paints or surface coatings that contain concentrations of lead greater than 0.1% by dry weight (1000 ppm), and less than 0.5% by dry weight (5000 ppm), is considered to be a "lead-containing paint or surface coating".

Paints or surface coatings that contain concentrations of lead at, or below, 0.1% by dry weight (1000 ppm) is considered to be a "low-level lead paint or surface coating".

Samples of any suspected lead-containing surface coatings were collected and submitted for laboratory analysis by Flame Atomic Absorption Spectroscopy (bulk samples) during this survey. All laboratories used by ECOH are accredited under the U.S. EPA National Environmental Lead Laboratory Accreditation Program (NLLAP) and/or American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP) to ensure consistent, accurate and defensible results.

Please refer to Table 2 for sample details and laboratory analysis results for paints scheduled for potential disturbance. For the laboratory chain of custody and the certificate of analysis, refer to Appendix II - Results of Bulk Sample Analysis for Asbestos & Lead.

Table 2: Summary of Analysis for Lead Samples

Sample Number	Location	Description	Analytical Results (ppm)
26974-Pb-1	Basement Stairwell (Loc. B-01)	Green Paint on Wall	**3,200 ppm**
26974-Pb-2	Stairwell Entrance	Off-White Paint on Wall, Trim and Doors	**96,000 ppm**

Table 2: Summary of Analysis for Lead Samples			
	(Loc. 1-01)		
26974-Pb-3	Kitchen (Loc. 1-03)	Brown Paint on Trim	**14,000 ppm**
26974-Pb-4	Building Exterior	Stone Mortar	69 mg/Kg
	- shading indicates sample result positive for lead (if applicable)		

Laboratory analysis determined the following samples as lead-based:

- **Off-White Paint on Walls, Trim and Doors** – throughout the Project Area **(96,000 ppm)**,
- **Brown Paint on Trim** - throughout the first floor **(14,000 pppm).**

Laboratory analysis determined the following samples as lead-containing:

- **Green Paint on Wall** - Basement Stairwell **(3,200 ppm)**

No other major sources of lead or lead-containing products were observed during this survey. However, lead may be present in:

- Internal batteries associated with emergency lighting system,
- Ceramic tile glazing,
- Wiring connectors and electric cable sheathing, and
- Solder joints on copper piping.

3.3 Mercury

Mercury is presumed to be present within wall-mounted thermostats throughout the Project Area.

Mercury is also present in minor quantities throughout the Project Area in the following forms:

- As a possible constituent of paints and adhesives, and
- As a vapour within fluorescent tubes lights.

3.4 Silica

Free crystalline silica, in the form of common construction sand, is present in all concrete and masonry products within the Project Area.

3.5 Mould

Mould-affected building materials were not identified within the Project Area at the time of assessment.

3.6 Ozone Depleting Substances (ODS)

Ozone depleting substances may be present in refrigeration and cooling units.

3.7 Polychlorinated Biphenyls (PCBs)

Fluorescent light ballasts observed in various locations throughout the Project Area may contain PCBs.

3.8 Other Designated Substances and Hazardous Materials

The following Designated Substances and Hazardous Materials were not noted in significant quantities or forms, if at all, during this survey; Acrylonitrile, Arsenic, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, Urea Formaldehyde Foam Insulation (UFFI), and Vinyl Chloride Monomer.

If present on site in insignificant quantities or forms, these Designated Substances and Hazardous Materials would not be expected to pose an immediate or potential risk to human health. Adequate worker protection should be achieved when implementing general health and safety precautions during general demolition or renovation activities.

4. CONCLUSIONS AND RECOMMENDATIONS

The following recommendations meet the requirements of the Occupational Health and Safety Act. Asbestos recommendations meet the requirements of the Designated Substance – Regulation respecting *Asbestos on Construction Projects and in Buildings and Repair Operations*, Ontario Regulation 278/05. Based upon review of historical reports, as well as analytical results and observations of this assessment, ECOH offers the following

4.1 Asbestos

Based on survey results, the following conclusion are made with regards to asbestos-containing materials (ACMs) within the Project Area:

- As asbestos-containing materials (ACM) are present with the Project Area, ECOH recommends that all workers have asbestos awareness and respirator training before commencing work. Asbestos awareness training will provide on-site workers; the understanding of asbestos-related health and safety issues; the ability to recognize ACM and any situation that may present a potential asbestos exposure, and the ability to respond appropriately to an inadvertent disturbance of ACM in the work area.
- Prior to removal or disturbance, if required, boilers/boiler interiors should be tested for asbestos-content. Alternatively, these materials can be assumed to contain asbestos, and the appropriate level of asbestos safety precautions must be implemented.
- Removal or disturbance of friable ACM (i.e., vinyl sheet flooring, parging cement, plaster) must employ Type 3 Asbestos Safety Precautions for the removal of more than one square meter of material.

- Removal or disturbance of friable ACM (i.e., vinyl sheet flooring, parging cement, plaster) must employ Type 2 asbestos safety precautions, at a minimum, for the removal of less than one square meter of material.
- Removal or disturbance of non-friable ACM (i.e., vinyl floor tiles, caulking) must employ Type 1 Asbestos Safety Precautions, at a minimum, if the material is wetted to control the spread of dust and the work is completed using non-powered hand-held tools.
- Any demolition, renovation or maintenance activities involving materials found NOT to contain asbestos, or not suspected of containing asbestos, should implement general health and safety precautions including, in part, the use of dust suppression techniques and appropriate respiratory protection.
- The asbestos-related findings of this report and any required removal of identified ACM should be used to update information within, or be inserted into, the facility's inventory of asbestos-containing building materials.
- During project work, if any additional materials are found beyond those which are described in this report or described in the existing inventory of asbestos-containing materials (i.e. materials not previously identified, or materials that are not homogenous to those previously identified, or materials that become revealed during the work), additional testing for asbestos-content should be completed immediately and prior to disturbance of the material. Alternatively, these materials can be assumed to contain asbestos, and the appropriate level of asbestos safety precautions must be implemented.
- Prior to renovation work, confirmed asbestos-containing materials that have the potential to be disturbed during the renovation work must be removed using asbestos safety procedures detailed within Ontario Regulation 278/05. Classification of the asbestos operation should be determined by an experienced and qualified person.

4.2 Lead

Any work involving the disturbance of building materials confirmed to be lead-based or lead-containing (i.e., paints throughout the Project Area) should be conducted following recommendations detailed within the Ministry of Labour document Guideline - *Lead on Construction Projects*, dated April 2011, and the Environmental Abatement Council of Canada (EACC) *Lead Guideline*, dated October 2014.

4.3 Mercury

The presence of mercury within wall-mounted thermostats, fluorescent tubes lights, paints and adhesives should not be considered a hazard provided the assembled units remain sealed and intact. Avoid direct skin contact with mercury and avoid inhalation of mercury vapour. Dispose of mercury following requirements of the Canada Environmental Protection Act, the Transportation of Dangerous Goods Act and provincial legislative requirements that may be applicable.

4.4 Mould

If present, water-damaged and mould-affected building materials should be removed following mould remediation protocols consistent with appropriate guidelines and industry best practices (i.e. Canadian Construction Association, Standard Construction Document CCA 82, 2004; *Mould Guidelines for the Canadian Construction Industry*, and the Environmental Abatement Council of Canada (EACC) document, *Mould Abatement Guidelines*, 3rd Edition – 2015).

4.5 Silica

Cutting, grinding, or demolition of materials containing silica should be completed using general health and safety precautions including the use of dust suppression techniques and appropriate respiratory protection, as is appropriate for the work being completed.

Removal of building materials containing silica should be completed following recommendations detailed within the Ministry of Labour document, *Guideline - Silica on Construction Projects*, dated, April 2011.

4.6 Polychlorinated Biphenyls (PCBs)

Fluorescent light ballasts should be removed and disassembled to observe serial codes which should be compared to standard PCB Identify Code literature. Ballasts with unidentifiable serial codes, or from manufacturers who are not included in the standard PCB Identifier Code literature or are not clearly labelled as “PCB Free”, or no date is clearly visible (ballasts dated 1981 or later do not contain PCBs), must be assumed to contain PCBs. Ballasts confirmed or assumed to contain PCBs must be disposed of following applicable legislative requirements (e.g., Canada Environmental Protection Act, the Transportation of Dangerous Goods Act and provincial legislative requirements as may be applicable).

5. STATEMENT OF LIMITATIONS

Due to the nature of building construction, and on-going building activities, some limitations exist to the thoroughness of a building assessment. The field observations, measurements and analysis are considered sufficient in detail and scope to form a reasonable basis for the findings and conclusions presented in this report. The observations, results and conclusions drawn by ECOH Management Inc. (ECOH) are limited to the specific scope of work for which ECOH was retained and are based solely on information generated as a result of the specific scope of work authorized by City of Toronto. Only those items that are capable of being observed and are reasonably obvious to ECOH personnel or have been identified to ECOH by other parties, can be reported. ECOH has exercised a degree of thoroughness and competence that is consistent with the profession during the execution of this assessment. ECOH considers the opinions and information as they are presented in this report to be factual at the time of the assessment. The conclusions are limited to the specific locations of where testing and/or observations were completed during the course of the assessment.

It is important to note that work was completed with the utmost care and our extensive expertise in carrying out assessments. ECOH believes that the information collected during the assessment concerning the Work Area is reliable. No other warranties are implied or expressed. ECOH, to the best of its knowledge, believes this report to be accurate, however, ECOH cannot guarantee the completeness or accuracy of information supplied to ECOH by third parties. It should also be noted that any investigation regarding the presence of hazardous materials in the work area is based on interpretation of conditions determined at specific sampling locations, and conditions may vary between sampling locations.

ECOH is an Environmental Consulting Company and as such any results or conclusions presented in this report should not be construed as legal advice. The material in this report reflects ECOH's professional interpretation of information available at the time of report preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ECOH accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Should additional information become available that suggests other environmental issues of concern beyond that described in this report, ECOH retains the right to review this information and modify conclusions and recommendations presented in this report accordingly.

6. CLOSURE

We trust this report meets your requirements. If you have any question, please contact the undersigned at 905-795-2800.

ECOH
Environmental Consulting
Occupational Health

Prepared by:

Naomi Pitcher, B.Env.Sc
Senior Environmental Scientist

Reviewed by:

Steve Bizi
Project Manager

APPENDIX I

Hazardous Materials Inventory Sheet

APPENDIX I - HAZARDOUS MATERIALS INVENTORY SHEET

Building Address	285 Spadina Road, Toronto	Date(s) of Current Survey:	February 9, 2022
Building Name	Spadina House Museum - **Stone Garage**	Organization completing Survey:	ECOH

Summary of Findings:

□

Location Number	*Location Name*	*Building System*	*Material Observed*	*Potential Hazardous Material*	*Sample ID*	*Asbestos Type/Content*	*Quantity*	*Condition*	*Notes/Required Action*
GA-	**Garage**								
GA-0-00	Exterior	Roof	Roofing Material	Asbestos	Not Sampled	**ACM Assumed**	1000 SF	Good	
GA-0-00	Exterior	Windows	Window Caulking	Asbestos	26974-ASB-09A-C	**4% Chrysotile**	250 LF	Good	Soft black window caulking
GA-0-00	Exterior	Walls	Caulking	Asbestos	26974-ASB-10A-C	None Detected	N/A	N/A	White caulking between stone and wood column
GA-0-00	Exterior	Walls	Stone Mortar	Asbestos	26974-ASB-08A-C	None Detected	N/A	N/A	
GA-0-00	Exterior	Walls	Stone Mortar	Lead	26974-Pb-4	< 69 mg/Kg - NEGATIVE (Trace concentrations only)	N/A	N/A	
GA-B-01	Basement	Floors	Concrete	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Walls	Concrete	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Walls	Plaster	Asbestos	26974-ASB-01A	None Detected	N/A	N/A	Plaster on stairwell to basement
GA-B-01	Basement	Walls	Paint - Green	Lead	26974-Pb-1	**3,200 ppm - POSITIVE**	150 SF	Poor	Green paint on plaster in stairwell to basement
GA-B-01	Basement	Walls	Concrete	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Structure	Wood	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Pipes	Horsehair	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Pipes	Uninsulated	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Duct	Uninsulated	N/A	N/A	N/A	N/A	N/A	
GA-B-01	Basement	Mechanical	Uninsulated	N/A	N/A	N/A	N/A	N/A	Furnace
GA-B-01	Basement	Mechanical	Uninsulated	N/A	N/A	N/A	N/A	N/A	Hot Water Tank
GA-B-01	Basement	Boiler 1	Parging Cement	Asbestos	2009-001A-C (b62802)	**50-75% Chrysotile**	25 SF	**Poor**	25 SF parging cement insulation on old boiler in POOR condition
GA-B-01	Basement	Boiler 1	Caulking	Asbestos	26974-ASB-05A-C	**1% Chrysotile**	10 LF	Good	Hard black caulking around boiler unit joint
GA-B-01	Basement	Boiler 2	N/A	Asbestos	Not Sampled	**ACM Assumed**	N/A	N/A	Boiler in operation and not accessible for sampling
GA-B-02	Pit Beneath Garage	Floors	N/A	N/A	N/A	N/A	N/A	N/A	* No Access to Area
GA-B-02	Pit Beneath Garage	Walls	N/A	N/A	N/A	N/A	N/A	N/A	* No Access to Area
GA-B-02	Pit Beneath Garage	Ceiling	N/A	N/A	N/A	N/A	N/A	N/A	* No Access to Area
GA-1-01	Stairwell Entrance	Floors	Vinyl Floor Tiles 2	Asbestos	2014A-0002A-C	**3% Chrysotile**	20 SF	Good	VFT02 - 12" x 12" brown with white streaks (mastic is non-asbestos)
GA-1-01	Stairwell Entrance	Walls	Plaster	Asbestos	26974-ASB-01B 2012 -0001A-E	None Detected	N/A	N/A	
GA-1-01	Stairwell Entrance	Walls	Paint - Off-White	Lead	26974-Pb-2	**96,000 ppm - POSITIVE**	N/A	N/A	Off-White paint on walls, trim and doors

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Asbestos Type/Content	Quantity	Condition	Notes/Required Action
GA-1-01	Stairwell Entrance	Ceiling	Plaster	Asbestos	2012 -0001A-E	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	80 SF	Good	
GA-1-02	Office	Floors	Wood	N/A	N/A	None Detected	N/A	N/A	
GA-1-02	Office	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-1-02	Office	Ceiling	Plaster	Asbestos	26974-ASB-02A-B 2012 -0001A-E	**2% Chrysotile**	300 SF	Good	
GA-1-03	Kitchen	Floors	Vinyl Sheet Flooring 5	Asbestos	2014A-0003A-C	None Detected	N/A	N/A	VSF05 - Brown beige white block pattern
GA-1-03	Kitchen	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-1-03	Kitchen	Walls	Paint - Brown	Lead	26974-Pb-3	**14,000 ppm - POSITIVE**	N/A	N/A	Brown paint on trim
GA-1-03	Kitchen	Ceiling	Plaster	Asbestos	2012 -0001A-E	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	280 SF	Good	
GA-1-04	Storage Room	Floors	Vinyl Sheet Flooring 5	Asbestos	2014A-0003A-C	None Detected	N/A	N/A	VSF05 - Brown beige white block pattern
GA-1-04	Storage Room	Walls	Plaster	Asbestos	26974-ASB-01C 2012 -0001A-E	None Detected	N/A	N/A	
GA-1-04	Storage Room	Ceiling	Plaster	Asbestos	2012 -0001A-E	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	80 SF	Good	
GA-1-05	Garage	Floors	Concrete	N/A	N/A	N/A	N/A	N/A	
GA-1-05	Garage	Walls	Rough Cast Cladding (Stucco)	Asbestos	26974-ASB-07A-C	None Detected	N/A	N/A	Coarse grey textured stucco on walls and ceilings
GA-1-05	Garage	Ceiling	Rough Cast Cladding (Stucco)	Asbestos	Not Sampled	Visually Consistent with 26974-ASB-07A-C (None Detected)	N/A	N/A	
GA-1-05	Garage	Pipes	Uninsulated	N/A	N/A	N/A	N/A	N/A	
GA-1-06	Washroom	Floors	Vinyl Sheet Flooring 5	Asbestos	2014A-0003A-C	None Detected	N/A	N/A	VSF05 - Brown beige white block pattern
GA-1-06	Washroom	Walls	Drywall Joint Compound	Asbestos	26974-ASB-03A-C	None Detected	N/A	N/A	
GA-1-06	Washroom	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-1-06	Washroom	Ceiling	Plaster	Asbestos	2012 -0001A-E	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	40 SF	Good	
GA-2-01	Kitchen	Floors	Vinyl Sheet Flooring 6	Asbestos	2014A-0004A-C	None Detected	N/A	N/A	VSF06 - Brown with 2" square pattern
GA-2-01	Kitchen	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-01	Kitchen	Ceiling	Plaster	Asbestos	Not Sampled	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	200 SF	Good	
GA-2-02	Storage Room	Floors	Wood	N/A	N/A	N/A	N/A	N/A	
GA-2-02	Storage Room	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-02	Storage Room	Ceiling	Drywall Joint Compound	Asbestos	Not Sampled	Visually Consistent with 26974-ASB-04A-E (None Detected)	N/A	N/A	
GA-2-03	Washroom	Floors	Vinyl Sheet Flooring 7	Asbestos	2014A-0005A-C	**25% Chrysotile**	150 SF	Good	VSF07 - Beige with diamond pattern
GA-2-03	Washroom	Walls	Plaster	Asbestos	26974-ASB-01D 2012 -0001A-E	None Detected	N/A	N/A	

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Asbestos Type/Content	Quantity	Condition	Notes/Required Action
GA-2-03	Washroom	Ceiling	Drywall Joint Compound	Asbestos	Not Sampled	Visually Consistent with 26974-ASB-04A-E (None Detected)	N/A	N/A	
GA-2-04	Office	Floors	Carpet	N/A	N/A	N/A	N/A	N/A	
GA-2-04	Office	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-04	Office	Ceiling	Drywall Joint Compound	Asbestos	26974-ASB-04A,B	None Detected	N/A	N/A	
GA-2-05	Office	Floors	Carpet	N/A	N/A	N/A	N/A	N/A	
GA-2-05	Office	Floors	Carpet - Mastic	Asbestos	26974-ASB-06A-C	None Detected	N/A	N/A	Beneath carpet and foam underlay
GA-2-05	Office	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-05	Office	Ceiling	Plaster	Asbestos	26974-ASB-02C 2012 -0001A-E	**2% Chrysotile**	250 SF	Good	Plaster on sloped roof section
GA-2-05	Office	Ceiling	Drywall Joint Compound	Asbestos	26974-ASB-04C	None Detected	N/A	N/A	Plaster on sloped roof section
GA-2-06	Sewing Room	Floors	Carpet	N/A	N/A	N/A	N/A	N/A	
GA-2-06	Sewing Room	Walls	Plaster	Asbestos	26974-ASB-01E 2012 -0001A-E	None Detected	N/A	N/A	
GA-2-06	Sewing Room	Ceiling	Drywall Joint Compound	Asbestos	26974-ASB-04D	None Detected	N/A	N/A	
GA-2-07	Corridor	Floors	Carpet	N/A	N/A	N/A	N/A	N/A	
GA-2-07	Corridor	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-07	Corridor	Ceiling	Plaster	Asbestos	26974-ASB-02D-E 2012 -0001A-E	**2% Chrysotile**	450 SF	Good	
GA-2-07	Corridor	Ceiling	Drywall Joint Compound	Asbestos	26974-ASB-04E	None Detected	N/A	N/A	
GA-2-07	Corridor	Pipes	Uninsulated	N/A	N/A	N/A	N/A	N/A	
GA-2-08	Closet	Floors	Carpet	N/A	N/A	N/A	N/A	N/A	
GA-2-08	Closet	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-08	Closet	Ceiling	Plaster	Asbestos	2012 -0001A-E	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	30 SF	Good	
GA-2-09	Closet	Floors	Carpet	N/A	N/A	N/A	N/A	N/A	
GA-2-09	Closet	Walls	Plaster	Asbestos	2012 -0001A-E	None Detected	N/A	N/A	
GA-2-09	Closet	Ceiling	Plaster	Asbestos	2012 -0001A-E	Visually Consistent with 26974-ASB-02A-E **(2% Chrysotile)**	30 SF	Good	

Surveyor's Field Notes

APPENDIX II

Results of Bulk Sample Analysis for Asbestos & Lead

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Tel/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order:	552202170
Customer ID:	55ECOH45
Customer PO:	26974
Project ID:	

Attention:	Naomi Pitcher	**Phone:**	(905) 795-2800
	ECOH Management, Inc.	**Fax:**	(905) 795-2870
	75 Courtneypark Drive West	**Received Date:**	02/09/2022 5:32 PM
	Unit 1	**Analysis Date:**	02/16/2022
	Mississauga, ON L5W 0E3	**Collected Date:**	02/08/2022
Project:	26974 - 285 Spadina Rd, TO - Spadina House Museum Stone Garage DSS		

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
26974-ASB- 01A-Skim Coat *552202170-0001*	Plaster - Wall Basement Stairwell (Loc. B-01)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01A-Rough Coat *552202170-0001A*	Plaster - Wall Basement Stairwell (Loc. B-01)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01B-Skim Coat *552202170-0002*	Plaster - Wall Stairwell Entrance (Loc. 1-01)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01B-Rough Coat *552202170-0002A*	Plaster - Wall Stairwell Entrance (Loc. 1-01)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01C-Skim Coat *552202170-0003*	Plaster - Wall Storage Room (Loc. 1-04)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01C-Rough Coat *552202170-0003A*	Plaster - Wall Storage Room (Loc. 1-04)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01D *552202170-0004*	Plaster - Wall Washroom (Loc. 2-03)	Gray/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01E-Skim Coat *552202170-0005*	Plaster - Wall Office (Loc. 2-06)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 01E-Rough Coat *552202170-0005A*	Plaster - Wall Office (Loc. 2-06)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 02A-Joint Compound *552202170-0006*	Plaster - Ceiling Office (Loc. 1-02)	White Non-Fibrous Homogeneous		98% Non-fibrous (Other)	2% Chrysotile
26974-ASB- 02A-Rough Coat *552202170-0006A*	Plaster - Ceiling Office (Loc. 1-02)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 02B-Joint Compound *552202170-0007*	Plaster - Ceiling Office (Loc. 1-02)				Positive Stop (Not Analyzed)

Initial report from: 02/16/2022 17:15:59

EMSL Canada Inc.
2756 Slough Street Mississauga, ON L4T 1G3
Tel/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order:	552202170
Customer ID:	55ECOH45
Customer PO:	26974
Project ID:	

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
26974-ASB- 02B-Rough Coat *552202170-0007A*	Plaster - Ceiling Office (Loc. 1-02)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 02C-Joint Compound *552202170-0008*	Plaster - Ceiling Office (Loc. 2-05)				Positive Stop (Not Analyzed)
26974-ASB- 02C-Skim Coat *552202170-0008A*	Plaster - Ceiling Office (Loc. 2-05)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 02D-Joint Compound *552202170-0009*	Plaster - Ceiling Corridor (Loc. 2-07)				Positive Stop (Not Analyzed)
26974-ASB- 02D-Rough Coat *552202170-0009A*	Plaster - Ceiling Corridor (Loc. 2-07)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 02E-Joint Compound *552202170-0010*	Plaster - Ceiling Corridor (Loc. 2-07)				Positive Stop (Not Analyzed)
26974-ASB- 02E-Rough Coat *552202170-0010A*	Plaster - Ceiling Corridor (Loc. 2-07)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 03A *552202170-0011*	Drywall Joint Compound - Wall Washroom (Loc. 1-06)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 03B *552202170-0012*	Drywall Joint Compound - Wall Washroom (Loc. 1-06)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 03C *552202170-0013*	Drywall Joint Compound - Wall Washroom (Loc. 1-06)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 04A *552202170-0014*	Drywall Joint Compound - Ceiling Office (Loc. 2-04)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 04B *552202170-0015*	Drywall Joint Compound - Ceiling Office (Loc. 2-04)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 04C *552202170-0016*	Drywall Joint Compound - Ceiling Office (Loc. 2-05)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 04D *552202170-0017*	Drywall Joint Compound - Ceiling Sewing Room (Loc. 2-06)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 04E *552202170-0018*	Drywall Joint Compound - Ceiling Corridor (Loc. 2-07)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 05A *552202170-0019*	Hard Black Caulking around Boiler Joint Basement (Loc. B-01)	Black Non-Fibrous Homogeneous		99% Non-fibrous (Other)	1% Chrysotile

Initial report from: 02/16/2022 17:15:59

EMSL Canada Inc.
2756 Slough Street Mississauga, ON L4T 1G3
Tel/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order:	552202170
Customer ID:	55ECOH45
Customer PO:	26974
Project ID:	

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
26974-ASB- 05B *552202170-0020*	Hard Black Caulking around Boiler Joint Basement (Loc. B-01)				Positive Stop (Not Analyzed)
26974-ASB- 05C *552202170-0021*	Hard Black Caulking around Boiler Joint Basement (Loc. B-01)				Positive Stop (Not Analyzed)
26974-ASB- 06A *552202170-0022*	Black Carpet Mastic Office (Loc. 2-05)	Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 06B *552202170-0023*	Black Carpet Mastic Office (Loc. 2-05)	Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 06C *552202170-0024*	Black Carpet Mastic Office (Loc. 2-05)	Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 07A *552202170-0025*	Rough Cast Cladding (Stucco) - Wall Garage (Loc. 1-05)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 07B *552202170-0026*	Rough Cast Cladding (Stucco) - Wall Garage (Loc. 1-05)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 07C *552202170-0027*	Rough Cast Cladding (Stucco) - Wall Garage (Loc. 1-05)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 08A *552202170-0028*	Exterior Stone Mortar	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 08B *552202170-0029*	Exterior Stone Mortar	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 08C *552202170-0030*	Exterior Stone Mortar	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 09A *552202170-0031*	Soft black exterior window caulking	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 09B *552202170-0032*	Soft black exterior window caulking	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 09C-Black Caulking *552202170-0033*	Soft black exterior window caulking	Black Non-Fibrous Homogeneous		96% Non-fibrous (Other)	4% Chrysotile
26974-ASB- 09C-Brown Caulking *552202170-0033A*	Soft black exterior window caulking	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 10A *552202170-0034*	Exterior White Caulking	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 10B *552202170-0035*	Exterior White Caulking	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26974-ASB- 10C *552202170-0036*	Exterior White Caulking	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 02/16/2022 17:15:59

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3

Tel/Fax: (289) 997-4602 / (289) 997-4607

http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order:	552202170
Customer ID:	55ECOH45
Customer PO:	26974
Project ID:	

Analyst(s)

Stephanie Achaiya (40)

Matthew Davis or other approved signatory
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Canada Inc. Markham, ON NVLAP Lab Code 600317-0

Initial report from: 02/16/2022 17:15:59

OrderID: 552202170

EMSL CANADA, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Chain of Custody

EMSL Order Number *(Lab Use Only)*: 552202170

EMSL CANADA, INC.
2756 SLOUGH STREET
MISSISSAUGA, ON L4T 1G3
PHONE: (289) 997-4602
FAX: (289) 997-4609

Company: ECOH		EMSL-Bill to: ☑ Same ☐ Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*	
Street: 75 Courtneypark Dr. W., Unit 1			
City: Mississauga	State/Province: Ontario	Zip/Postal Code: L5W 0E3	Country: Canada
Report To (Name): Naomi Pitcher, Steve Bizi		Fax #: 905-795-2870	
Telephone #: 905.795.2800		Email Address: npitcher; sbizi@ecoh.ca	
Project Name/Number: 26974 - 285 Spadina Rd, TO - Spadina House Museum Stone Garage DSS			
Please Provide Results: ☐ Fax ☑ Email	Purchase Order:	U.S. State Samples Taken:	

Turnaround Time (TAT) Options* - Please Check

☐ 3 Hours ☐ 6 Hours ☐ 24 Hrs ☐ 48 Hrs ☐ 3 Days ☐ 4 Days ☑ 5 Days ☐ 10 Days

**For TEM Air 3 hours/6 hours, please call ahead to schedule. *There is a premium charge for 3 Hour TEM AHERA or EPA II TAT. You will be asked to sign an authorization form for this service Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide.*

PCM - Air
- ☐ NIOSH 7400
- ☐ w/ OSHA 8hr. TWA

PLM - Bulk (reporting limit)
- ☑ PLM EPA 600/R-93/116 (<1%)
- ☐ PLM EPA NOB (<1%)

Point Count
- ☑ 400 (<0.25%) ☐ 1000 (<0.1%)

Point Count w/Gravometric
- ☐ 400 (<0.25%) ☐ 1000 (<0.1%)
- ☐ NYS 198-1 (friable in NY)
- ☐ NYS 198-1 NOB (non-friable-NY)
- ☐ NIOSH 9002 (<1%)

TEM - Air
- ☐ AHERA 40 CFR, Part 763
- ☐ NIOSH 7402
- ☐ EPA Level II
- ☐ ISO 10312

TEM - Bulk
- ☐ TEM EPA NOB
- ☐ NYS NOB 198.4 (non-friable-NY)
- ☐ Chatfield SOP
- ☐ TEM Mass Anaylsis-EPA 600 sec 2.5

TEM - Water: EPA 100.2
- Fibres > 10µm ☐ Waste ☐ Drinking
- All Fibre Sizies ☐ Waste ☐ Drinking

TEM-Dust
- ☐ Microvac - ASTM D 5755
- ☐ Wipe - ASTM D6480
- ☐ Carpet Sonication (EPA 600/J-93/167)

Soil/Rock/Vermiculite
- ☐ PLM CARB 435 - A (0.25% sensitivity)
- ☐ PLM CARB 435 - B (0.1% sensitivity)
- ☐ TEM CARB 435 - B (0.1% sensitivity)
- ☐ TEM CARB 435 - C (0.01% sensitivity)
- ☐ EPA Protocol (Semi-Quantitative)
- ☐ EPA Protocol (Quantitative)

Other: ☐

☑ **Check For Positive Stop - Clearly Identify Homogenous Group**

Samplers Name: Naomi Pitcher **Samplers Signature:** NP

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
26974-ASB- 01A	Plaster - Wall Basement Stairwell (Loc. B-01)	N/A	February 8, 2022
26974-ASB- 01B	Plaster - Wall Stairwell Entrance (Loc. 1-01)	N/A	February 8, 2022
26974-ASB- 01C	Plaster - Wall Storage Room (Loc. 1-04)	N/A	February 8, 2022
26974-ASB- 01D	Plaster - Wall Washroom (Loc. 2-03)	N/A	February 8, 2022
26974-ASB- 01E	Plaster - Wall Office (Loc. 2-06)	N/A	February 8, 2022
26974-ASB- 02A	Plaster - Ceiling Office (Loc. 1-02)	N/A	February 8, 2022

Client Sample # (s): 26974-ASB-01A - 26974-ASB-10C **Total # of Samples:** 36

Relinquished (Client): Naomi Pitcher **Date:** February 9, 2022 **Time:** 5:32

Received (Lab): EMSLLab55IFP **Date:** 02/09/22 **Time:** 5:32PM IDB

Comments/Special Instructions:

OrderID: 552202170

EMSL CANADA, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Chain of Custody

EMSL Order Number *(Lab Use Only):*

05 Q202170

EMSL CANADA, INC.
2756 SLOUGH STREET
MISSISSAUGA, ON L4T 1G3
PHONE: (289) 997-4602
FAX: (289) 997-4609

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
26974-ASB-02B	Plaster - Ceiling Office (Loc. 1-02)	N/A	February 8, 2022
26974-ASB-02C	Plaster - Ceiling Office (Loc. 2-05)	N/A	February 8, 2022
26974-ASB-02D	Plaster - Ceiling Corridor (Loc. 2-07)	N/A	February 8, 2022
26974-ASB-02E	Plaster - Ceiling Corridor (Loc. 2-07)	N/A	February 8, 2022
26974-ASB- 03A	Drywall Joint Compound - Wall Washroom (Loc. 1-06)	N/A	February 8, 2022
26974-ASB- 03B	Drywall Joint Compound - Wall Washroom (Loc. 1-06)	N/A	February 8, 2022
26974-ASB- 03C	Drywall Joint Compound - Wall Washroom (Loc. 1-06)	N/A	February 8, 2022
26974-ASB- 04A	Drywall Joint Compound - Ceiling Office (Loc. 2-04)	N/A	February 8, 2022
26974-ASB- 04B	Drywall Joint Compound - Ceiling Office (Loc. 2-04)	N/A	February 8, 2022
26974-ASB- 04C	Drywall Joint Compound - Ceiling Office (Loc. 2-05)	N/A	February 8, 2022
26974-ASB- 04D	Drywall Joint Compound - Ceiling Sewing Room (Loc. 2-06)	N/A	February 8, 2022
26974-ASB- 04E	Drywall Joint Compound - Ceiling Corridor (Loc. 2-07)	N/A	February 8, 2022
26974-ASB- 05A	Hard Black Caulking around Boiler Joint Basement (Loc. B-01)	N/A	February 8, 2022
26974-ASB- 05B	Hard Black Caulking around Boiler Joint Basement (Loc. B-01)	N/A	February 8, 2022
26974-ASB- 05C	Hard Black Caulking around Boiler Joint Basement (Loc. B-01)	N/A	February 8, 2022
26974-ASB- 06A	Black Carpet Mastic Office (Loc. 2-05)	N/A	February 8, 2022
26974-ASB- 06B	Black Carpet Mastic Office (Loc. 2-05)	N/A	February 8, 2022
26974-ASB- 06C	Black Carpet Mastic Office (Loc. 2-05)	N/A	February 8, 2022
26974-ASB- 07A	Rough Cast Cladding (Stucco) - Wall Garage (Loc. 1-05)	N/A	February 8, 2022
26974-ASB- 07B	Rough Cast Cladding (Stucco) - Wall Garage (Loc. 1-05)	N/A	February 8, 2022
26974-ASB- 07C	Rough Cast Cladding (Stucco) - Wall Garage (Loc. 1-05)	N/A	February 8, 2022
26974-ASB- 08A	Exterior Stone Mortar	N/A	February 8, 2022
26974-ASB- 08B	Exterior Stone Mortar	N/A	February 8, 2022

***Comments/Special Instructions:**

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

552202170

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
26974-ASB- 08C	Exterior Stone Mortar	N/A	February 8, 2022
26974-ASB- 09A	Soft black exterior window caulking	N/A	February 8, 2022
26974-ASB- 09B	Soft black exterior window caulking	N/A	February 8, 2022
26974-ASB- 09C	Soft black exterior window caulking	N/A	February 8, 2022
26974-ASB- 10A	Exterior White Caulking	N/A	February 8, 2022
26974-ASB- 10B	Exterior White Caulking	N/A	February 8, 2022
26974-ASB- 10C	Exterior White Caulking	N/A	February 8, 2022

***Comments/Special Instructions:**

EMSL Canada Inc.
2756 Slough Street, Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	552202133
CustomerID:	55ECOH45
CustomerPO:	26974
ProjectID:	

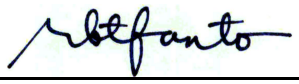
Attn: **Naomi Pitcher**
ECOH Management, Inc.
75 Courtneypark Drive West
Unit 1
Mississauga, ON L5W 0E3

Phone:	(905) 795-2800
Fax:	(905) 795-2870
Received:	2/9/2022 05:30 PM
Collected:	2/8/2022

Project: **26974 - 285 Spadina Rd, TO - Garage DSS**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client SampleDescription	*Collected*	*Analyzed*	*Weight*	*RDL*	*Lead Concentration*
26974-Pb- 1	2/8/2022	2/10/2022	0.2511 g	80 ppm	3200 ppm
552202133-0001	Site: Green Paint on Wall, Basement Stairwell (B-01)				
26974-Pb- 2	2/8/2022	2/10/2022	0.2489 g	4000 ppm	96000 ppm
552202133-0002	Site: Off-White Paint on Wall, Trim & Doors, Stairwell Entrance (Loc. 1-01)				
26974-Pb- 3	2/8/2022	2/10/2022	0.2500 g	400 ppm	14000 ppm
552202133-0003	Site: Brown Paint on Trim, Kitchen (Loc. 1-03)				



Rowena Fanto, Lead Supervisor
or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted.
* Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON AIHA-LAP, LLC - ELLAP #196142

Initial report from 02/16/2022 09:03:40

EMSL Canada Inc.
2756 Slough Street, Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	552202133
CustomerID:	55ECOH45
CustomerPO:	26974
ProjectID:	

Attn: **Naomi Pitcher**
ECOH Management, Inc.
75 Courtneypark Drive West
Unit 1
Mississauga, ON L5W 0E3

Phone:	(905) 795-2800
Fax:	(905) 795-2870
Received:	2/9/2022 05:30 PM
Collected:	2/8/2022

Project: **26974 - 285 Spadina Rd, TO - Garage DSS**

Test Report: Lead in Soils by Flame AAS (SW 846 3050B/7000B)*

Client SampleDescription	*Collected*	*Analyzed*	*Weight*	*RDL*	*Lead Concentration*
26974-Pb- 4	2/8/2022	2/14/2022	0.5057 g	40 mg/Kg	69 mg/Kg
552202133-0004	Site: Exterior Stone Mortar				

Rowena Fanto, Lead Supervisor
or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted.
* Analysis following Lead in Soil/Solids by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 40 mg/kg based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
Samples analyzed by EMSL Canada Inc. Mississauga, ON AIHA-LAP, LLC - ELLAP #196142

Initial report from 02/16/2022 09:03:40

OrderID: 552202133

EMSL CANADA, INC.
LABORATORY • PRODUCTS • TRAINING

Lead (Pb) Chain of Custody
EMSL Order Number *(Lab Use Only)*:

552202133

EMSL CANADA, INC.
2756 SLOUGH STREET
MISSISSAUGA, ON L4T 1G3
PHONE: (289) 997-4602
FAX: (289) 997-4609

Company: ECOH	**EMSL-Bill to:** ☑ Same ☐ Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 75 Courtneypark Dr. W., Unit 1	
City: Mississauga **State/Province:** Ontario	**Zip/Postal Code:** L5W 0E3 **Country:** Canada
Report To (Name): Naomi Pitcher, Steve Bizi	**Telephone #:** 647-270-5480
Email Address: npitcher@ecoh.ca, sbizi@ecoh.ca	**Fax #:** 905-795-2870 **Purchase Order:**
Project Name/Number: 26974 - 285 Spadina Rd, TO - Garage DSS	**Please Provide Results:** ☐ Fax ☑ Email
U.S. State Samples Taken:	**CT Samples:** ☐ Commercial/Taxable ☐ Residential/Tax Exempt

Turnaround Time (TAT) Options* - Please Check

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☑ 1 Week ☐ 2 Week

**Analysis completed in accordance with EMSL's Terms and Conditions located in the Price Guide*

Matrix	Method	Instrument	Reporting Limit	Check
Chips ☐ % by wt. ☐ mg/cm² ☑ ppm	SW846-7000B	Flame Atomic Absorption	0.01%	☑
Air	NIOSH 7082	Flame Atomic Absorption	4 µg/filter	☐
	NIOSH 7105	Graphite Furnace AA	0.03 µg/filter	☐
	NIOSH 7300 modified	ICP-AES/ICP-MS	0.5 µg/filter	☐
Wipe* ASTM ☐ non-ASTM ☐ *if no box is checked, non-ASTM Wipe is assumed	SW846-7000B	Flame Atomic Absorption	10 µg/wipe	☐
	SW846-6010B or C	ICP-AES	1.0 µg/wipe	☐
TCLP	SW846-1311/7000B/SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW846-1131/SW846-6010B or C	ICP-AES	0.1 mg/L (ppm)	☐
Soil	SW846-7000B	Flame Atomic Absorption	40 mg/kg (ppm)	☐
	SW846-6010B or C	ICP-AES	2 mg/kg (ppm)	☐
Wastewater Unpreserved ☐ Preserved with HNO_3 pH <2 ☐	SM3111B/SW846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)	☐
	EPA200.7	ICP-AES	0.020 mg/L (ppm)	☐
Drinking Water Unpreserved ☐ Preserved with HNO_3 pH <2 ☐	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)	☐
	EPA 200.8	ICP-MS	0.0031mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50 (2013)	ICP-MS	1.2 µg/filter	☐
Other:				☐

Name of Sampler: Naomi Pitcher **Signature of Sampler:** NP

Sample #	Location	Volume/Area	Date/Time Sampled
26974-Pb- 1	Green Paint on Wall Basement Stairwell (B-01)	N/A	February 8, 2022
26974-Pb- 2	Off-White Paint on Wall, Trim & Doors Stairwell Entrance (Loc. 1-01)	N/A	February 8, 2022
26974-Pb- 3	Brown Paint on Trim Kitchen (Loc. 1-03)	N/A	February 8, 2022
26974-Pb- 4	Exterior Stone Mortar	N/A	February 8, 2022

RECEIVED EMSL CANADA INC. 2022 FEB -9 P 5:34

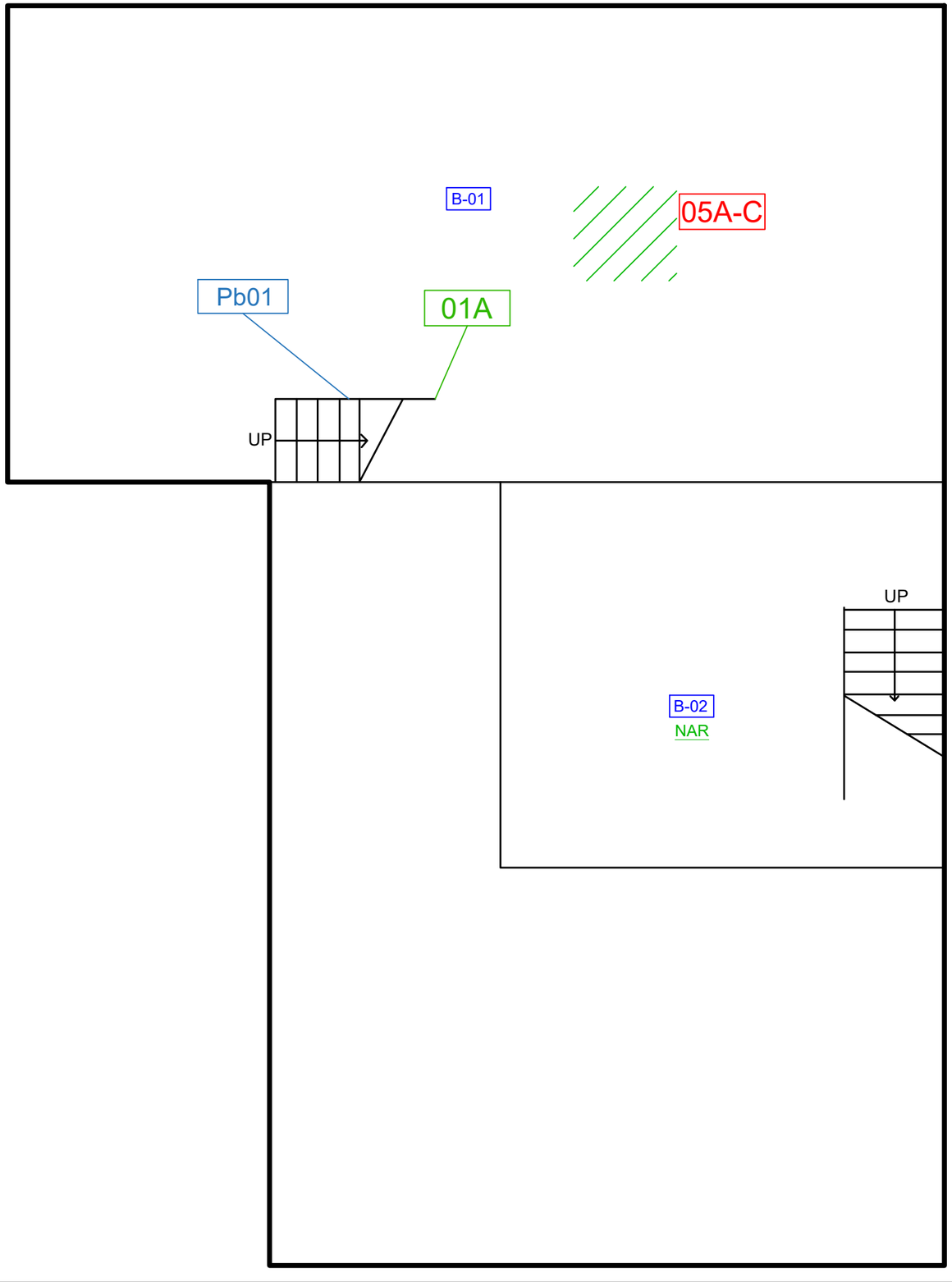
Client Sample # (s):	26974-PB-1 - 26974-Pb-4		**Total # of Samples:**	4	
Relinquished (Client):	Naomi Pitcher	**Date:** February 9, 2022	**Time:**		
Received (Lab):	EMSL Lab SS/FP	**Date:** 02/09/22	**Time:**	5:32PM/DB	

Comments/Special Instructions:

Page 1 of 1 pages

APPENDIX III

Survey Drawings (“Area of Investigation”)



N

Legend

- Asbestos-containing Parging Cement and Caulking on Boiler
- 1-01 — Location Number
- NAR — No Access to Room
- Pb01 — Negative Lead Sample Location Number
- Pb01 — Positive Lead Sample Location Number
- 01a — Negative Asbestos Sample Location
- 01a — Positive Asbestos Sample Location

The drawing does not illustrate locations of window caulking or roofing materials.

Figure 1

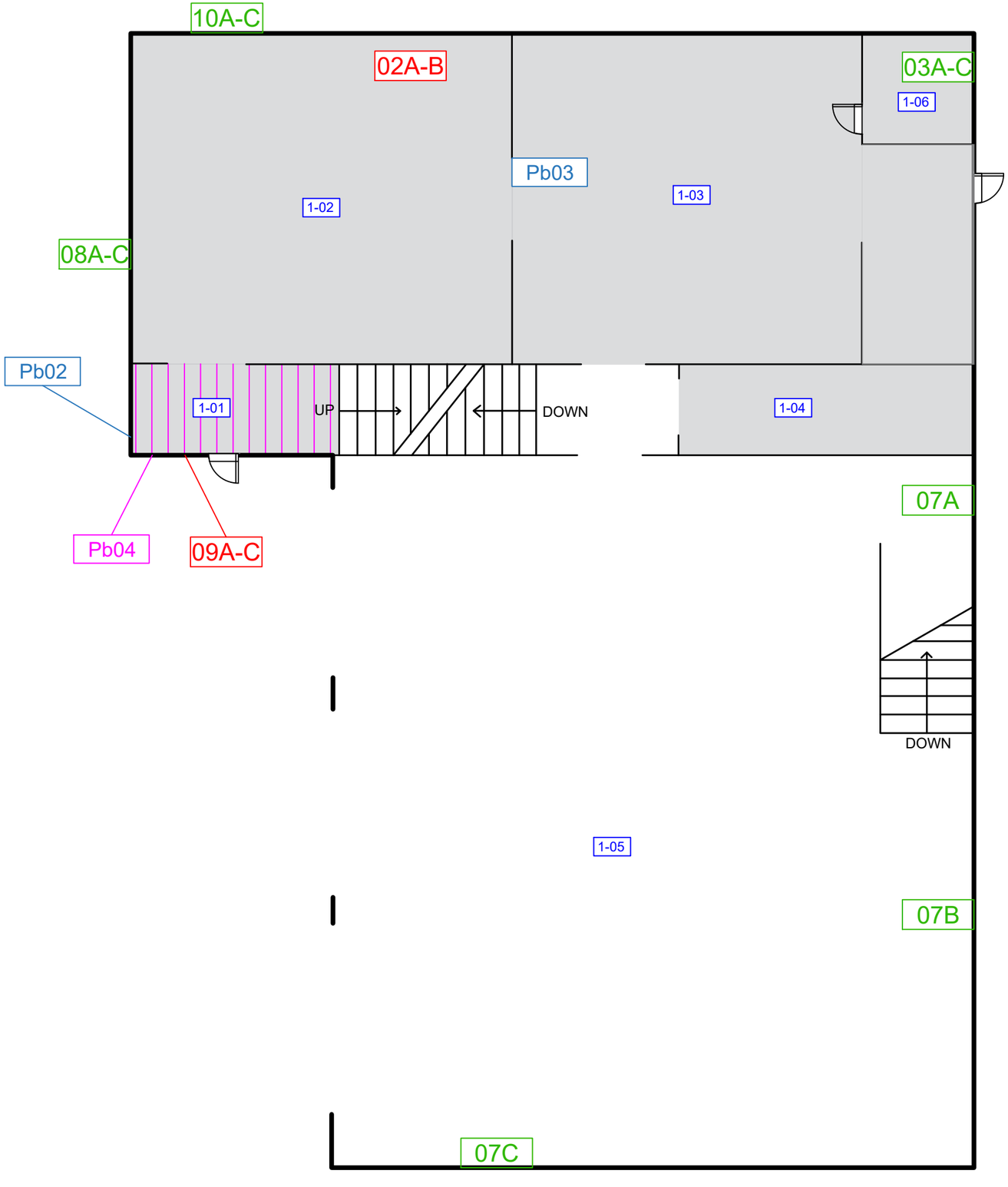
LOCATION:
285 Spadina Road,
Toronto,Ontario

BUILDING NAME:
Spadina House Museum

Garage-Basement Floor Plan
Pre-Renovation Designated Substances and Hazardous Materials Survey

CLIENT: City of Toronto			
PROJECT NUMBER: 26974	DATE: February 2022	DRW BY: AN	
CAD FILE: FIG1-3 P26974 DSS CoT	SCALE: Not to Scale	CHK BY: NP	

TORONTO



Legend

- Asbestos-containing Vinyl Floor Tiles
- Asbestos-containing Plaster
- 1-01 — Location Number
- NAR — No Access to Room
- Pb01 — Negative Lead Sample Location Number
- Pb01 — Positive Lead Sample Location Number
- 01a — Negative Asbestos Sample Location
- 01a — Positive Asbestos Sample Location

The drawing does not illustrate locations of window caulking or roofing materials.

Figure 2

LOCATION:

285 Spadina Road,
Toronto,Ontario

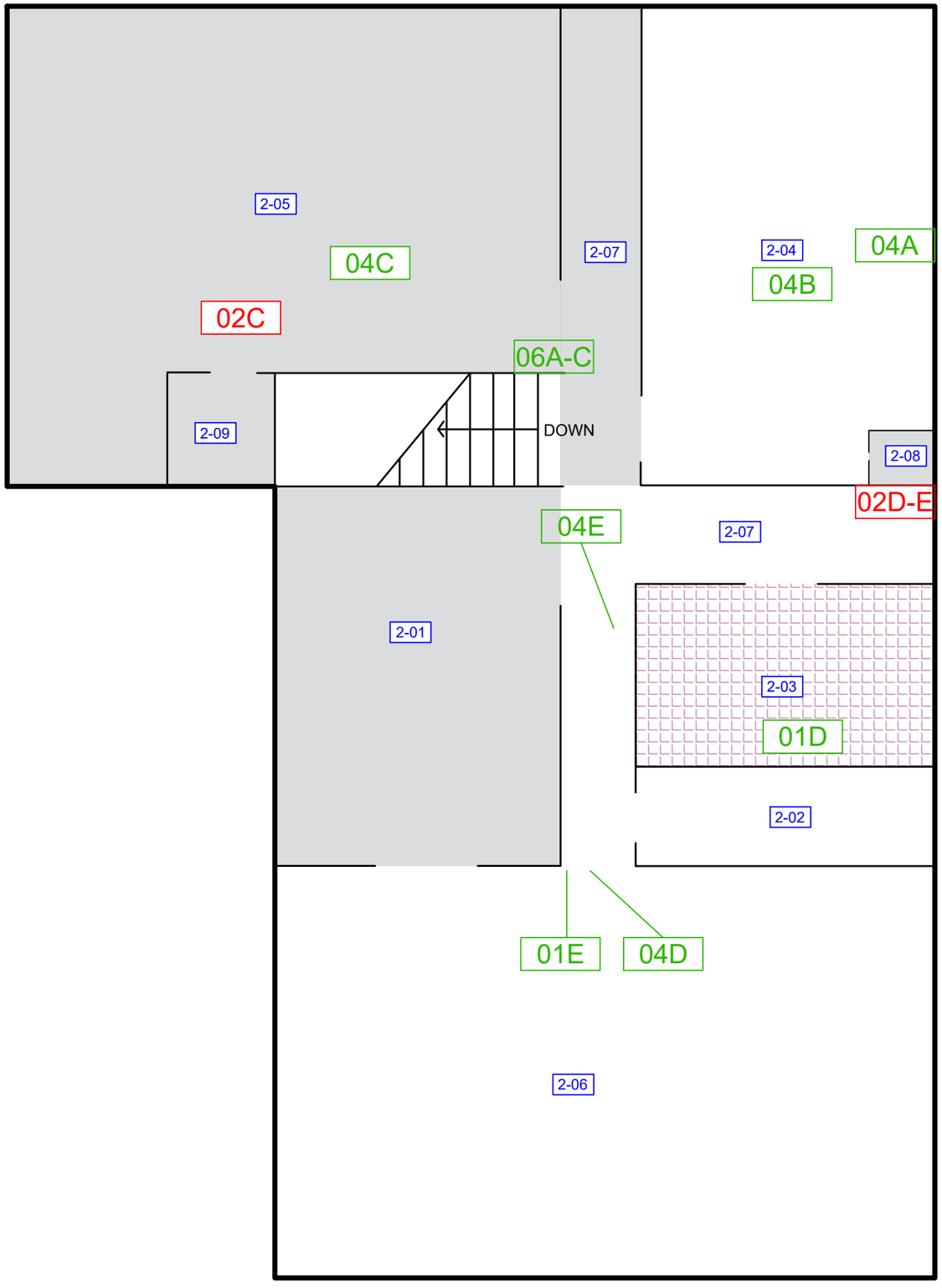
BUILDING NAME:

Spadina House Museum

Garage-Basement Floor Plan
Pre-Renovation Designated Substances and Hazardous Materials Survey

CLIENT: City of Toronto			
PROJECT NUMBER: 26974	DATE: February 2022	DRW BY: AN	
CAD FILE: FIG1-3 P26974 DSS CoT	SCALE: Not to Scale	CHK BY: NP	

TORONTO



N

Legend

- Asbestos-containing Vinyl Sheet Flooring
- Asbestos-containing Plaster
- 1-01 — Location Number
- NAR — No Access to Room
- Pb01 — Negative Lead Sample Location Number
- Pb01 — Positive Lead Sample Location Number
- 01a — Negative Asbestos Sample Location
- 01a — Positive Asbestos Sample Location

The drawing does not illustrate locations of window caulking or roofing materials.

Figure 3

LOCATION:

285 Spadina Road,
Toronto,Ontario

BUILDING NAME:

Spadina House Museum

Garage-Basement Floor Plan
Pre-Renovation Designated Substances and Hazardous Materials Survey

CLIENT: City of Toronto			
PROJECT NUMBER: 26974	DATE: February 2022	DRW BY: AN	
CAD FILE: FIG1-3 P26974 DSS CoT	SCALE: Not to Scale	CHK BY: NP	

TORONTO

APPENDIX IV

Site Photographs

SITE PHOTOGRAPHS

Client Name:	Project Location:	Project No.
City of Toronto	Spadina House Museum - Stone Garage 285 Spadina Road, Toronto, ON	26974

Photo No. 1. **Date:** February 8, 2022 **Location:** Throughout Project Area **Description:** **Asbestos-containing (1% Chrysotile)** plaster on ceilings throughout the Project Area.	

Photo No. 2. **Date:** February 8, 2022 **Location:** Basement (Loc. B-01) **Description:** POOR Condition **asbestos-containing (50-75% Chrysotile)** parging cement on boiler. Access to boiler interior was not possible during assessment and materials are therefore **assumed to contain asbestos**.	

Client Name:	Project Location:	Project No.
City of Toronto	Spadina House Museum - Stone Garage 285 Spadina Road, Toronto, ON	26974

Photo No. 3. **Date:** February 8, 2022 **Location:** Basement (Loc. B-01) **Description:** **Asbestos-containing (1% Chrysotile)** hard black caulking around boiler joint.	

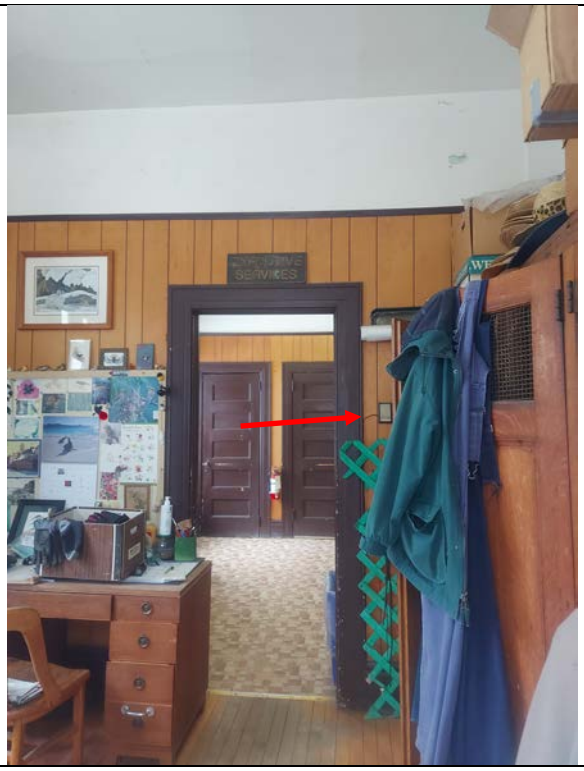
Photo No. 4. **Date:** February 8, 2022 **Location:** Stairwell Entrance (Loc. 1-01) **Description:** **Asbestos-containing (3% Chrysotile)** 12”x12” Brown with white streaks vinyl floor tile (VFT02).	

Client Name:	Project Location:	Project No.
City of Toronto	Spadina House Museum - Stone Garage 285 Spadina Road, Toronto, ON	26974

Photo No. 5. **Date:** February 8, 2022 **Location:** Upstairs Washroom (Loc. 2-03) **Description:** **Asbestos-containing (25% Chrysotile)** Beige with diamond pattern Vinyl Sheet Flooring (VSF07).	

Photo No. 6. **Date:** February 8, 2022 **Location:** Building Exterior (Loc. 0-00) **Description:** **Asbestos-containing (4% Chrysotile)** soft black window caulking on building exterior windows.	

Client Name:	Project Location:	Project No.
City of Toronto	Spadina House Museum - Stone Garage 285 Spadina Road, Toronto, ON	26974

Photo No. 7.	
Date: February 8, 2022	
Location: Kitchen (Loc. 1-02)	
Description: Representative photo of thermostat.	

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for concrete floor sealer and polished concrete floor. Work in accordance with the Contract Drawings.

.2 Refer to drawingd for areas to receive the Work.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish; Control and formed expansion and contraction joints and joint devices.

1.3 REFERENCES

.1 ACI 301 - Structural Concrete.

.2 ACI 302 - Guide for Concrete Floor and Slab Construction.

.3 ASTM E1155/E1155M - Determining F Floor Flatness and F Floor Levelness Numbers.

1.4 SUBMITTALS

.1 Section 01 33 00 – Submittal Procedures.

.2 Product Data: Provide data on [concrete hardener,] [sealer,] [and] [slip resistant treatment], compatibilities, and limitations.

.3 Reports: Submit manufacturer's acceptance of substrate prior to installation in writing. Submit verification of moisture content of floor prior to installation.

1.5 MAINTENANCE DATA

.1 Section 01 78 10 – Closeout Submittals.

.2 Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.6 QUALITY ASSURANCE

.1 Perform Work of polished concrete by a company that has a minimum of five years proven experience in installation of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

1.7 MOCK-UP

.1 Section 01 45 00 – Quality Control: Provide mock-up of floor finish.

.2 Construct mock-up area under conditions similar to those which will exist during actual placing, 3'-0"x 3'-0" wide, with coatings showing Level 2 medium sheen finish (Satin).

.3 Locate where directed.

.4 Mock-up may remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, protect, and handle products to site to Section 01 61 00 – Product Requirements.

.2 Deliver materials in manufacturer's packaging including application instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Temporary Lighting: Minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.

.2 Do not finish floors until interior heating system is operational.

.3 Temporary Heat: Ambient temperature of 10 degrees C minimum.

.4 Do not install the Work outside of environmental ranges as recommended by the manufacturer with Product manufacturer's written acceptance and as follows:

.1 Relative Humidity: In accordance with manufacturer's requirements.

.2 When no dust is being raised.

.3 In well-ventilated and broom clean area.

1.10 COORDINATION

.1 Section 01 31 00 – Project Management and Coordination.

.2 Coordinate the work with concrete floor placement and concrete floor curing.

PART 2 Products

2.1 MANUFACTURERS

.1 Concrete Sealer:

.1 Alkali-silicate, water-souluble, inorganic concrete hardener and dustproofer; 'Kure-N-Harden' by BASF Building Systems or approved alternative by Sika Canada Inc.

.2 Polished Concrete:

.1 Magnesium fluorosilicate concrete hardener and dustproofer; 'Lapidolith' by BASF Building Systems or approved alternatve.

2.2 SLIP RESISTANT TREATMENT

.1 Slip Resistant Finish: Silica sand type additives, compatible with product used for concrete sealer and polished concrete.

Execution

2.3 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation: Verify site conditions.

.2 Verify that floor surfaces are acceptable to receive the work of this section.

2.4 PREPARATION

.1 Prepare substrate in accordance with manufacturer's written instructions. Diamond grind and vacuum substrate free of debris and dust.

.2 Protect adjacent surfaces from damage resulting from Work. Mask and/or cover adjacent surfaces, fixtures and equipment as necessary.

.3 For polished concrete floor, grind concrete surface starting with 30/60 grit and moving up through grit sequence to 1500 grit in number of passes required to achieve required finish.

.4 Polished concrete to provide medium gloss/reflectance finish level with Level 2 sheen.

.5 Clean surface to be sealed as recommended by sealer manufacturer.

2.5 APPLICATION (FOR CONCRETE FLOOR SEALER)

.1 Apply concrete floor sealer in accordance with manufacturer's written instructions. Sealer manufacturer shall supervise application.

.2 Spray apply concrete sealer to entire surface and keep from drying for 30 minutes as recommended by manufacturer.

.3 Sprinkler suface with water as sealer beings to penetrate (after 30 minutes).

.4 Flush surface with water and drying begins to remove excess material. Allow to harden for 24 hours.

.5 Lightly buff floor with a commercial floor buffer and non-aggressive pad to bring up required sheen.

.6 Apply second coat of concrete sealer following same procedures as first layer.

2.6 APPLICATION (FOR POLISHED CONCRETE FLOOR)

.1 Apply minimum three coatings of sealer to entire surface in accordance with manufacturer's written instructions. Diluted ratio as recommended by manufacturer.

.2 Lightly buff floor with a commercial floor buffer and non-aggressive pad to bring up required sheen.

.3 Provide anti-slip coating to flooring surface.

2.7 CLEANING AND PROTECTION

.1 Remove promptly as work progresses spilled or spattered materials from surface of work. Clean floors on completion of work.

.2 Erect barriers to prevent the entry for 48 hours following completion of application.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-place Concrete.

.2 Section 04 05 19 - Masonry Anchorage and Reinforcing: Reinforcement for masonry.

1.3 REFERENCE STANDARDS

.1 CSA A23.1:19/A23.2:19 Concrete materials and methods of concrete construction/test methods and standard practices for concrete

.2 CSA A23.3:19 Design of concrete structure

.3 STD G40.20/G40.21-13 General requirements for rolled or welded structural quality steel/structural quality steel

.4 CSA W186:21 Welding of reinforcing bars in reinforced concrete construction

.5 Manual of standard practice

1.4 ACTION SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, supporting and spacing devices.

1.5 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

1.6 QUALITY ASSURANCE

.1 Perform Work in accordance with CSA-A23.1/A23.2.

.2 Welders' Certificates: Submit to Section 01 43 00, Manufacturer's Certificates, certifying welders employed on the Work, verifying CSA-qualification within the previous 12 months.

Part 2 Products

2.1 REINFORCEMENT

.1 Reinforcing Steel, Deformed: CSA-G30.18, billet steel, Grade 400W, weldable bars, unfinished.

.2 Welded Wire Fabric (WWF) to be 152 x 152 x MW 18.7 x MW 18.7 (6" x 6" x 6ga x 6 ga).

2.2 ACCESSORIES

.1 Tie Wire:

.1 Epoxy coated.

.2 Minimum 1.65 mm annealed type

.2 Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapour barrier puncture.

.1 Chairs, bolsters, bar supports and spacers are to be precast concrete, plastic or steel. Wood, clay brick and concrete block is not acceptable.

.3 Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.3 FABRICATION

.1 Fabricate concrete reinforcing in accordance with:

.1 CSA-A23.1/A23.2.

.2 RSIC Manual of Standard Practice.

.2 Weld reinforcement to CSA-W186.

Part 3 Execution

3.1 PLACEMENT

.1 Place, support and secure reinforcement against displacement to CSA-A23.1/A23.2 and as indicated on reviewed placing Drawings.

.2 Do not displace or damage vapour barrier.

.3 Accommodate placement of formed openings.

.4 Maintain concrete cover around reinforcing as follows:

.1 40mm (1.5") for concrete placed in formwork for 15M or small bars

.2 50mm (2") for concrete placed in formwork for 20M or larger bars

.3 65mm (2.5") for slab on grade, top of slab to top layer of steel.

.4 75mm (3") for concrete placed against earth (bottom of footings)

.5 Chairs shall be used to maintain the specified concrete cover.

.6 Conform to applicable code for concrete cover over reinforcement.

.7 Bond and ground all reinforcement to requirements of Section 26 05 26.

3.2 FIELD QUALITY CONTROL

.1 Inspection and Testing:

.1 Section 01 45 00: Field inspection.

END OF SECTION

PART 1 General

.1 Conform to the requirements of Division 1.
.2 Section 32 16 00 Concrete Paving

1.2 REFERENCES

.1 ASTM International (ASTM)

.1 ASTM A143/A143M-07(2014) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
.2 ASTM A497 - 99 Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
.3 ASTM A775/A775M-19 Standard Specification for Epoxy-Coated Steel Reinforcing Bars
.4 ASTM D3963/D3963M-15 Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars
.5 ASTM A1064/A1064M-17 Standard Specification for Carbon-Steel Wire and Welded Wire

.2 American Concrete Institute (ACI)

.1 ACI SP-66 (04) ACI Detailing Manual.

.3 CSA Group (CSA)

.1 CSA-A23.1-14/ CSA-A23.2-14 Concrete Materials and Methods of Concrete Construction/ Methods of Test Methods and Standard Practice for Concrete.
.2 CSA A23.3-14 Design of Concrete Structures.
.3 CSA G30.18-09 (R2014) Carbon Steel Bars for Concrete Reinforcement.
.4 CSA G40.20-13/G40.21-13 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.5 CSA W186-M1990 (R2012) Welding of Reinforcing Bars in Reinforced Concrete Construction

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC Reinforcing Steel Manual of Standard Practice.

1.3 SUBMITTALS

.5 Make submittals in accordance with Section 01 33 00 – Shop Drawings.

.6 Shop Drawings:

.1 Submit shop drawings, including placing drawings and bar lists.
.2 Prepare placing drawings and bar lists in accordance with the American Concrete Institute (ACI) Detailing Manual, and the Reinforcing Steel Institute of Canada (RSIC) Reinforcing Steel Manual of Standard Practice, the typical details included with Contract Documents.
.3 Prepare placing drawings to minimum scale of 1:50.
.4 Submit placing drawings and bar lists sufficiently detailed and dimensioned to permit correct placement of reinforcement and accessories without reference to architectural or structural Drawings.
.5 Show concrete cover to reinforcement.

.7 Show location of construction joints. Inspection Reports: Inspection and Testing Company shall submit reports of inspections and tests.

.1 Distribute inspection reports as follows:
.1 Prime Consultant.
.2 Landscape Consultant.
.3 Contractor.

.8 Quality Assurance Submittals:

.1 Mill Test Report: upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.
.2 Upon request submit in writing to Consultant proposed source of reinforcement material to be supplied.

1.4 QUALITY ASSURANCE

.1 Obtain a copy of CSA A23.1 and maintain on site.

.2 Qualifications: Welding: Undertake welding of reinforcement only by a fabricator or Subcontractor approved by Canadian Welding Bureau to requirements of CSA W186.

.3 Source Quality Control: Source Quality Control may be performed by an Inspection and Testing Company appointed by Consultant.

.4 Review provided by Inspection and Testing Company does not relieve Contractor of his sole responsibility for quality control over Work. Performance or non-performance of Inspection and Testing Company shall not limit, reduce, or relieve Contractor of his responsibilities in complying with the requirements of the Specification.

.5 Identify and correlate reinforcing steel from Canadian mills with test reports for compliance with requirements specified.

.6 Test unidentified reinforcing steel at expense of Contractor. Perform testing for each 1

tonne or part thereof supplied for incorporation in Work.

1.5 SHIPPING, HANDLING AND STORAGE

.1 Refer to Section 01 62 00 – Products & Substitutions.

.2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.6 Waste Management and Disposal

.1 Refer to Section 01 74 00 – Cleaning & Waste Management.

2 Products

2.1 MATERIALS

.1 In accordance with reference standards.

.2 Substitute different size bars only if permitted in writing by Consultant.

.3 Bar Reinforcing Steel:

.1 Bars which are to be welded by arc-welding process: to CSA G30.18, Grade 400W.
.2 Other bars: to CSA G30.18, Grade 400R. Plain round bars: to CSA G40.20-04/G40.21.
.3 Plain round bars: to CSA G40.20-04/G40.21.
.4 Epoxy Coated Bar Reinforcing Steel: to ASTM A775.
.5 Welded Wire Fabric: to ASTM A1064/A1064M and in flat sheets, not rolls.
.6 Cold-drawn annealed steel wire ties: to ASTM A497.
.7 Chairs, bolsters, bar supports, spacers: to CSA A23.1.
.8 Mechanical splices: subject to approval of Consultant.

2.2 FABRICATION

.1 Fabricate reinforcing steel only in permanent fabricating shop.

.2 Fabricate reinforcing steel in accordance with shop drawings.

.3 Tag reinforcing bars to indicate placement as designated on shop drawings.

.4 Splices:

.1 Provide splices only where specifically indicated on Drawings.
.2 Stagger alternate mechanical splices 750 mm apart.
.3 Stagger alternate end bearing splices 750 mm apart.
.4 Install on threaded splices, plastic internal coupler thread protector and plastic bar end thread protector.

3 Execution

3.1 EXAMINATION

.1 Before starting this work, examine work done by others which affects this work.

.2 Examine formwork to verify that it has been completed, and adequately braced in place.

.3 Notify the Consultant of any conditions which would prejudice proper completion of this work.

.4 Commencement of work implies acceptance of existing conditions.

3.2 INSTALLATION

.1 Place reinforcing steel in accordance with reviewed placing drawings, typical details, and CSA A23.3.

.2 Handling of epoxy coated reinforcing as per ASTM D3963.

.3 Adequately support reinforcing and secure against displacement within tolerances permitted.

.4 Place reinforcing steel to provide minimum spacing and proper concrete cover as noted on drawings.

.5 Do not cut reinforcement to incorporate other Work.

.6 Relocate or re-bend bars only on written instructions of Consultant.

.7 Tie reinforcement in place. Do not weld.

3.3 ADJUSTING

.1 Adjust and secure reinforcement in correct position immediately before concrete is placed.

.2 Remove contaminants which lessen bond between concrete and reinforcement.

3.4 FIELD QUALITY CONTROL

.1 Provide competent supervisor, with at least three years of experience in reinforcement placement, to direct placement of reinforcement.

.2 Inspect placement of reinforcement for conformance with Drawings and Specifications, before each concrete placement, and correct as necessary.

.3 Consultant's periodic review of selected areas of reinforcement are for verification of conformity to design concept and general arrangement only and shall not relieve Contractor of responsibility for quality control, errors, or omissions, or conformance with requirements of Contract Documents.

3.5 DEFECTIVE WORK

.1 Incorrectly fabricated, misplaced or omitted reinforcement will be considered defective Work.

.2 Replace or adjust defective reinforcement before concrete is placed as directed by Consultant.

.3 Replace or strengthen concrete work which is deficient as a result of incorrectly fabricated, misplaced, or omitted reinforcement, which was not corrected before concrete was placed.

.4 Pay for additional inspection and testing, redesign, corrective measures, and related expenses, if Work has proven to be deficient.

3.6 Cleaning

.1 Proceed in accordance with Section 01 74 00 – Cleaning & Waste Management.

END OF SECTION

PART 1 General

1.1 RELATED WORK

.1 Section 31 05 16 – Aggregate Materials
.2 Section 32 16 00 – Concrete Paving
.3 Section 32 33 00 – Exterior Site Furnishings

1.2 MEASUREMENT FOR PAYMENT

.1 Measurement of payment to be as specified in the pricing form including construction of compacted base, steel reinforcement and all incidental items as shown on the details and drawings.

1.3 REFERENCES

.1 ASTM International (ASTM)
1. ASTM C260/C260M-10a (2016) Standard Specification for Air Entraining Admixtures for Concrete
2. ASTM C309-11 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
3. ASTM C330/C330M-14 Standard Specification for Lightweight Aggregates for Structural Concrete
4. ASTM C494/C494M-15a Standard Specification for Chemical Admixtures for Concrete
5. ASTM C881/C881M-14 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
6. ASTM C1017/C1017M-13e1 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
7. ASTM C1107/C1107M-14a Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
8. ASTM D412-16 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
9. ASTM D624-00(2012) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
10. ASTM D1751-18 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
11. ASTM D2240-15e1 Standard Test Method for Rubber Property—Durometer Hardness

.1 American Concrete Institute (ACI)
.1 ACI 117-10, Standard Specifications for Tolerances for Concrete Construction and Materials.
.2 ACI 232.1R-12, Use of Raw or Processed Natural Pozzolans in Concrete

.3 CSA Group (CSA)
.1 CSA-A23.1-14/ CSA-A23.2-14 Concrete Materials and Methods of Concrete Construction/ Methods of Test Methods and Standard Practice for Concrete.
.2 CSA A283-06 (R2011) Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-18 Cementitious Materials Compendium

.4 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS 1010, Material Specification for Aggregates - Granular A, B, M and Select Subgrade Material.

.2 OPSS 1212, Material Specification for Hot-Poured Rubberized Asphalt Joint Sealing Compound.

1.4 INSPECTION AND TESTING

.1 Concrete testing: to current CAN/CSA-A23.2 by testing agency. Accelerated test methods will apply. Payments, hiring and scheduling for concrete testing by Contractor from materials testing allowance.

.2 Give the testing agency minimum 24h notice before each concrete pour.

.3 Comply with the requirements of Section 01 45 00 - Quality Control.

.4 Conform to current CSA Standard CAN3-A23.2-M90.

.5 Concrete testing to include:

.1 A standard strength test for concrete placed, but not less than one test for concrete placed each day. Each strength test sample will consist of three cylinders with proper identification and field data. One specimen will be tested at 7 days and 28 days. Cylinders will be field cured prior to shipping to the test laboratory.

.2 One standard air entrainment test for each standard strength test.

.3 One or more standard slump test with each standard strength test. The Contract Administrator may require additional testing for each truck load placed, as deemed necessary.

.6 Concrete may be rejected prior to placement if:

.1 Concrete fails to conform with the specified mix design.

.2 The concrete placement does not begin within 2 hours from plant batch time.

.3 The concrete is older than 2 hours from plant batch time.

.4 The concrete has undergone less than 70 or more than 100 revolutions at the mixing speed.

.7 Concrete test compressive strength: Concrete will be considered under strength if:

.1 The average of any day's tests of each class of concrete is below specified strength.

.2 Any single test falls below 80 percent of the specified strength. In case of dispute, the Contractor may have two 100mm DIA cores from the concrete drilled and tested at his own expense, in accordance with the current CSA Standard CAN3-A23.2-M90. The results shall be applied in the manner outlined above.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and all necessary details of reinforcing.

.3 Detail reinforcing steel in accordance with Manual of Standard Practice of Reinforcing Steel Institute of Ontario (RSIO).

.4 Each drawing submitted showing formwork design shall be in accordance with the current CAN/CSA-A23.1, and bearing stamp and signature of professional engineer registered or licensed in province Ontario, Canada.

PART 2 Products

2.1 MATERIALS

.1 Concrete work materials and measurements to conform to applicable details.

.2 Portland cement: to current CAN/CSA-A5, Type 10.

.3 Coloured Concrete: See Section 32 16 00 - Concrete Paving.

.4 Shrinkage compensating grout: pre-mixed, non-metallic aggregate, 50 MPa at 28 days.

.5 Reinforcing bars: to current CAN/CSA-G30.18, Grade 400.

.6 Welded steel wire fabric: to current CSA-G30.5

.7 Waterstops: extruded ribbed PVC strips, 12 MPa tensile strength, minimum 350% elongation, minus 45ºC to plus 80ºC working temperature, sizes as indicated.

.8 Premoulded joint filler: bituminous impregnated fibreboard to current ASTM D 1751.

.9 Joint sealer/filler: black, cold applied, to current CAN/CGSB-19.20, Type 1.

.10 Sealer: proprietary poly-siloxane resin blend.

.11 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel, insulation filled.

.12 Non-shrink grout: premixed compound consisting of metallic aggregate, cement, water, reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 45 Mpa at 28 days.

.13 Dry pack: premixed of non-premixed composition of non-metallic aggregate,

cement and sufficient water for the mixture to retain its shape when made into a ball of hand and capable of developing compression strength of 32 Mpa at 28 days.

.14 All other concrete materials: to current CAN/CSA-A23.1.

2.1 CONCRETE MIXES

.1 The proportions and qualities of cement, water and aggregate shall conform to the CSA Specifications A23.1-M, latest revision, for “READY MIX CONCRETE”.

.2 Concrete shall be supplied from a Ready Mixed Concrete Supplier certified by the “Ready Mixed Concrete Association of Ontario” to the following minimum requirements:

.1 Compressive Strength: 32 Mpa in 28 days.
.2 Cement Content: 335 kg/m³.
.3 Exposure: Class C2.
.4 Water/Cement Ratio: 0.45.
.5 Maximum size of aggregates: 20mm.
.6 Maximum slump: 80 mm +/-10 mm
.7 Air Entrainment: 5% to 8%.

.3 The Contract Administrator reserves the right to take whatever corrective action is needed if the concrete fails to meet the requirements of this specification or shows defects after placing. The Contractor shall facilitate any needed investigation or inspection of the work.

2.2 MIX PROPORTIONS

.1 Method: Alternative 1 of current CAN/CSA-A23.1.

.2 Cement type: as specified under 2.1.

.3 Minimum 28-day compressive strengths and exposure classifications:
.1 Pavements, walks, curbs and exposed site concrete: 32 MPa; C-2.
.2 All other concrete in accordance with applicable details.

.4 Nominal size of coarse aggregate: Clause 14 of current CAN/CSA-A23.1.

.5 Slump: to Table 6 of current CAN/CSA-A23.1.

.6 Air content: all concrete to contain purposely entrained air in accordance with Table 10 of current CAN/CSA-A23.1.

.7 Admixtures: to Clause 6 of current CAN/CSA-A23.1.

PART 3 Execution

3.1 WORKMANSHIP

.1 Obtain Contract Administrator approval before placing concrete.

.2 Place concrete in accordance with current CAN3-A23.1-M90.

.3 Ensure reinforcement and inserts are not disturbed during concrete placement.

.4 Obtain Contract Administrator approval of proposed method for protection of concrete during placing and curing in adverse weather, prior to placing of concrete.

.5 Maintain accurate records of cast-in-place concrete items to indicate date, location of pour, air temperature and test samples taken.

3.2 INSTALLATION

.1 Backfilling: Backfill the underside of the curbs, walls, etc. with 19mm crushed run limestone, compacted to 98% Standard Proctor Maximum Dry Density, as detailed.

.2 Placing Formwork: design, fabrication, erection and use of concrete formwork shall conform to the current requirements of CSA Standard S269.3.

.3 Forms shall be constructed with temporary ports or openings at the bottom of all deep units such as columns and walls to facilitate cleaning and inspection.

.4 For treated formwork surfaces the materials used as a parting agent shall be non-staining. The amount of material used shall be kept to a minimum and any that adheres to reinforcing steel shall be removed. When the concrete surfaces are to receive a permanent finish coating, the parting agent shall be compatible with the coating.

.5 Prior to placing concrete, a suitable means for checking the alignment and elevations of forms during placing shall be provided. These checks shall be made frequently during the placing of the concrete, and adjustments to the formwork and falsework made as required until all concrete is in place.

.6 Forms where used shall remain in place at least 8 hours after the concrete has been placed against them. Where the air temperature drops below 10ºC at any time during the 8-hour period the forms shall be left in place for such additional time as is necessary to prevent damage to the edges. Curing of the exposed concrete shall begin immediately upon removal of the forms.

.7 Placing Joints: Crack-control joints shall be cut within 24 hours using power-driven abrasive or diamond blades. Cutting of joints shall begin as soon as the cut is made and before shrinkage cracks form in the concrete.

.1 The depth of the control joints shall be between a quarter and a third of the thickness of the slab or wall.
.2 Control of construction joints to the surface plane, as shown on drawings.
.3 Maximum interval not to exceed 2 meters or as shown on drawings.
.4 Placing Expansion Joint: material should be placed to full depth to isolate any rigid structure encountered in the line of the work, and place expansion joints to the full depth of the concrete curb at a maximum of 6 meters spacing.

.8 Placing Concrete: All concrete shall be placed under the following conditions:

.1 Each load shall have correct air content.
.2 Slump tests shall be taken on the first load of concrete arriving on the job site, and thereafter at the discretion of the Contract Administrator.
.3 In dry forms accepted by the Testing Agency.
.4 As near as possible to its final position.
.5 Maximum vertical drop from chutes shall be 1.5m.
.6 Evenly on both sides of the expansion joints so as to retain their vertical position.
.7 Forms shall be filled with an excess of concrete thoroughly spaded, compacted and struck off to its required level in such a manner as to force the coarse aggregate below the surface of the mortar.
.8 Air temperature shall be 5ºC and rising, and all necessary precautions shall be taken during cold weather.
.9 No concrete shall be placed on frozen ground.
.10 Concrete shall have a temperature of no less than 10ºC and no more than 38ºC at the time of the placing, and means acceptable to the Testing Agency shall be provided to maintain these limits for 72 hours after placing.

.9 Concrete Finishing and Form Stripping: The formwork may be stripped after initial set of the concrete has been achieved.

.10 On exposed formed surfaces, neatly chip off fins, unsightly ridges or other imperfections; fill small surface voids with grout and rub flush with the general surfaces.

.11 All exposed surfaces to have broom finish.

.12 Rub exposed sharp edges of concrete with Carborundum to produce 3mm radiused edges unless otherwise detailed.

.13 Slope surfaces as indicated on plan.

3.3 INSERTS

.1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, water stops, joint fillers and other inserts required to be built-in. Sleeves and openings greater than 100mm x 100mm not indicated, must be approved by the Contract Administrator.

3.4 CURING

.1 Concrete surfaces shall be cured for 3 days at a minimum temperature of 10ºC or for the time necessary to attain 35% of the specified 28 day compressive strength of the concrete.

.2 Concrete shall be cured by the installation of a curing compound of polyethylene vapour barrier ensuring complete coverage of the concrete.

3.5 COLD WEATHER WORK

.1 Take cold weather precautions whenever the ambient temperature is, or is expected to be, at or below 5 ºC.

.2 Have protective measures in place, or adjacent to the work before any concrete is mixed or ordered.

.3 Maintain concrete temperature between 10ºC and 20ºC for a minimum of 3 days for unloaded areas, and 6 days for areas receiving partial load. These durations may be reduced by 33% with the use of high early strength cement.

.4 In methods employed to maintain the concrete temperature, provide suitable access for inspection.

3.6 FINISHES

.1 Concrete surfaces shall have a medium to light broom finish with grooves running perpendicular to the path of travel.

3.7 CONTROL JOINTS

.1 Cut control joints in slabs on grade as indicated in the Contract Drawing Details, in accordance with current CAN/CSA-A23.1. Fill with specified joint sealer/filler.

3.8 EXPANSION AND ISOLATION JOINTS

.1 Install pre-moulded joint filler in expansion and isolation joints full depth of slab flush with finished surface.

3.9 CURING

.1 Cure and protect concrete in accordance with current CAN/CSA-A23.1, except that curing compounds shall not be used where bond is required by subsequent topping or coating.

3.10 GROUT

.1 Grout voids under baseplates.

.2 Grout into place, bolts and other items of concrete hardware, that are not placed prior to pouring concrete.

.3 Mix and place grout.

3.11 SEALING

.1 Following curing, apply poly-siloxane resin blend sealer treatment to exposed surfaces.

.2 Apply poly-siloxane resin blend sealer at 4 m^2/L.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Cast-in-place concrete foundation walls floors and slabs on grade.

.2 Control, expansion and contraction joint devices associated with concrete work including embedments and joint sealants.

1.2 RELATED REQUIREMENTS

.1 Section 03 20 00 - Concrete Reinforcing.

.2 Section 05 12 00 - Structural Steel: Steel columns and beams.

.3 Section 05 31 13 - Steel Floor Decking.

.4 Section 05 31 23 - Steel Roof Decking.

1.3 REFERENCE STANDARDS

.1 CSA A23.1:19/A23.2:19 Concrete materials and methods of concrete construction/test methods and standard practices for concrete

.2 CSA A23.3 Design of Concrete Structures

1.4 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Test Data: Minimum four (4) weeks prior to starting concrete work, submit manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:

.3 Concrete Mix Design: Provide submittal of proposal concrete mix design for consultant review prior to starting construction work.

.4 Certification: Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA-A23.1/A23.2.

.5 Certification: Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1/A23.2.

.6 Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.

1.5 QUALITY ASSURANCE

.1 Perform Work in accordance with CSA-A23.1/A23.2.

.2 Maintain one (1) of document on site.

.3 Acquire cement and aggregate from same source for all work.

.4 Conform to CSA-A23.1/A23.2 when concreting during hot weather.

.5 Conform to CSA-A23.1/A23.2 when concreting during cold weather.

Part 2 Products

2.1 CONCRETE MATERIALS

.1 Hydraulic Cement: CSA-A3000, Type GU; Grey colour.

.2 Blended Hydraulic Cement: CSA-A3000, Type GUb ; Grey colour.

.3 Fine Aggregates: Normal density aggregates, graded to CSA-A23.1/A23.2

.4 Coarse Aggregates: Normal density aggregates, graded to CSA-A23.1/A23.2

.5 Water: CSA-A23.1/A23.2, clean and not detrimental to concrete.

2.2 ACCESSORIES

.1 Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 17 MPa in 48 hours and 48 MPa in 28 days.

2.3 CONCRETE CLASS

.1 Classes of concrete shall be placed in the locations noted:

Class of Concrete	Location
C-1	Exterior structurally reinforced slabs
C-2	Exterior unreinforced slab on grade, curbs
F-2	Exterior walls, columns and piers
N-CF	Interior concrete floor slabs that are not subjected to freezing or chlorides
N-1	Interior piers and foundation walls not exposed to freezing
N-1	Interior concrete on composite floor deck
N-2	Footings

.2 Classes of concrete shall have the following mix requirements:

Class of Concrete	Strength	W/C Ratio	Air Entrainment	Chloride Ion
C-1	35 MPa (56 days)	0.40	5%-8%	<1500 Coulombs at 91d
C-2	32 MPa	0.45	5%-8%	
F-2	25 MPa	0.55	4%-7%	
N-CF	25 MPa	0.55		
N-1	25 MPa	0.55		
N-1	25 MPa	0.55		
N-2	20 MPa			

.3 Use accelerating admixtures in cold weather only when approved by Consultant. Use of admixtures will not relax cold weather placement requirements.

.4 Use calcium chloride only when approved by Engineer.

.5 Use set retarding admixtures during hot weather only when approved by Engineer.

.6 Add air entraining agent to normal weight concrete mix for work exposed to exterior.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

.2 Verify all dimensions and locations required on drawings.

.3 Verify requirements for concrete cover over reinforcement.

.4 Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not impede concrete placement.

.5 Verify locations of all openings and embedments required for other structural work.

3.2 PREPARATION

.1 Prepare previously placed concrete and apply bonding agent to manufacturer's written instructions.

.2 In locations where new concrete is dowelled to existing work, drill holes in existing concrete, with size as shown on Drawings.

.3 Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

3.3 PLACING CONCRETE

.1 Place concrete in accordance with CSA-A23.1/A23.2 and CSA A23.3

.2 Notify Consultant minimum fourty eight (48) hours prior to commencement of operations.

.3 Ensure reinforcement, embedded parts are not disturbed during concrete placement.

.4 Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

.5 Place concrete continuously between predetermined expansion, control, and construction joints.

.6 Do not interrupt successive placement; do not permit cold joints to occur.

.7 Saw cut joints to a minimum 1/4 depth of slab thickness within twenty-four (24) hours after placing. The maximum center/center spacing for saw-cut shall be 24 times the depth.

.8 Fill sawcuts and construction joints with semi-rigid, flexible epoxy joint filler, to the manufacturer's specifications.

.1 Acceptable fillers for interior joints : W.R. Meadows Rezi-Weld Flex, Sika Loadflex or Approved Alternate.

.2 Acceptable fillers for exterior joints: Formex Canseal Clear NS or Approved Alternate

.9 Do not add water to concrete on site.

.10 Do not hard trowel or machine trowel air entrained concrete slabs

.11 Use high frequency vibration to place all concrete.

3.4 TOLERANCES

.1 Slab and Floor Tolerances: To CSA-A23.1/A23.2, to tolerance schedule as indicated.

.2 Slab and Floor Tolerances: To CSA-A23.1/A23.2, using F-number method in accordance with ASTM E1155M. Tolerance measurement shall be made a maximum of 72 hours after completion of each floor placement.

3.5 CONCRETE FINISHING

.1 Finish concrete floor surfaces to requirements of Section 03 35 00 and architectural drawings.

3.6 CURING AND PROTECTION

.1 Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical damage.

.1 Hot weather protection is required for all concrete placed where it is forecasted that the temperature will be at or above 27C at the time of placement.

.2 Take adequate measures to protect concrete from exposure to freezing temperatures at least seven days after concrete placement. Cold weather protection is required for all concrete placed where it is forecasted that the temperature will drop below 5C within 24 hours of placement.

.2 Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

.3 Cure floor surfaces in accordance with CSA-A23.1/A23.2.

.4 All concrete shall be kept moist during the first three days of curing. Concrete floors shall be covered in plastic for the first three days of curing.

3.7 FIELD QUALITY CONTROL

.1 Inspection and Testing:

.1 Provide free access to Work and cooperate with appointed firm.

.2 All concrete to be tested by a CSA certified concrete testing laboratory. Contractor to provide copies of testing report to consultant for review.

.3 Submit proposed mix design of each class of concrete to testing firm for review prior to commencement of Work.

.4 Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

.5 Minimum Three (3) concrete test cylinders will be taken. Not less than one strength test shall be made for each 100 m^3 of concrete with at least three (3) tests for each class of concrete used, per day.

.6 One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

.7 Provide one concrete air entrainment test for each pour of air entrained concrete.

3.8 PATCHING

.1 Allow Consultant to inspect concrete surfaces immediately upon removal of forms.

.2 Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Consultant upon discovery.

3.9 DEFECTIVE CONCRETE

.1 Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

.2 Repair or replacement of defective concrete will be determined by the Consultant.

.3 Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Consultant for each individual area.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for architectural concrete Work in accordance with the Contract Drawings.

.2 All exposed concrete to be architectural concrete.

1.2 RELATED SECTIONS

.1 Section 03 20 00 – Concrete Reinforcement and Accessories.

.2 Section 03 30 00 - Cast-in-Place Concrete

1.3 REFERENCES

.1 ASTM C 494, Chemical Admixtures for Concrete.

.2 CAN/CSA-A23.1/.2, Concrete Materials and Methods of Concrete Construction.

.3 CAN/CSA-A23.3, Design of Concrete Structures.

.4 CAN/CSA A23.4, Precast Concrete-Materials and Construction Code.

.5 CAN/CSA-S16.1, Limit States Design of Steel Structures.

.6 CSA O121, Douglas Fir Plywood.

.7 CAN/CSA-S269.3, Concrete Formwork.

1.4 SUBMITTALS

.1 Section 01 33 00 – Submittal Procedures.

- .1 Submit shop drawings indicating:
  - .1 Panel joints and cone tie locations, show distribution of panels to provide minimum ½ sheet size through-out exposed locations.
  - .2 Design mix calculations and details of release agent.
- .2 Submit following samples
  - .1 600 x 600 mm samples of each panels finish.
  - .2 six duplicate 300 x 300 x 50 mm samples for preliminary selection of colours and aggregates.

1.5 QUALITY ASSURANCE

.1 Design architectural concrete in accordance with CAN/CSA-A23.1, .2, .3 and .4 and CAN/CSA-S16.1. Construct to 50% of allowable tolerances and 28 day compressive strength.

1.6 MOCK-UP

.1 Section 01 45 00 – Quality Control: Provide mock-up of floor finish.

.2 Construct one beam and two stub column designated by Consultant for the purpose of determining casting procedures and vibration techniques, to examine segregation of concrete and to make any final adjustments to mix design, joint design, concrete colour, and to evaluate surface appearance. Size of prototype members, 800 mm deep x 300 mm wide beam size and 300 mm x 300 mm x 7000 mm high column with beam intersecting at approximately mid-height. Place mock-up in a temporary location acceptable to Consultant and remove when directed.

.3 Include two form panels in order to determine joints between panels and to demonstrate tight joints without grooved joints or the formation of projecting fins of concrete.

.4 Erect a wall and circular column sample as directed at a permanent location in Building designated by Consultant for examination and acceptable of appearance of colour, surface finish, details, jointing, assembly and alignment.

.5 Adjust sample installation at no extra cost to Owner as required to obtain acceptance. Accepted samples may become part of permanent work, and shall be minimum standard to which balance of Work shall match, subject to passing of tests.

PART 2 Products

2.1 MATERIALS

.1 Cement, Aggregates, Admixtures and Mix designs: ‘Agilia Concrete’ by Lafarge or approved alternative in accordance with requirements of Division 3. Cement used for Architectural Concrete shall be supplied from a single kiln run.

.2 Aggregates:

.1 In accordance with CAN/CSA-A23.1, and in general, maximum size no greater than one-quarter thickness of concrete section being poured. Maximum coarse aggregate dimension; 19 mm. Aggregate shall be supplied in one batch to avoid colour variations.

.2 Exposed aggregate for face mix shall have max. dimension of 13 mm and crushed material of colour necessary to produce exposed surfaces which will match sample panel as per Art. 1.4.3. Maintain single source of aggregate for duration of Contract.

.3 Pigments: non-staining, non-bleeding, non-fading, metallic oxide of type acceptable to Consultant to produce general colour range of final finish. Products of Northern Pigments, Harcros Pigments Canada, and L.M. Scofield are acceptable.

.4 Admixtures: CAN/CSA-A23.1. Water reducing, cement dispersing agent is acceptable; use air entrainment for concrete exposed to exterior environment.

.1 Superplasticizer: ASTM C 494, Type F or G, free of chlorides and alkalies, and shall be of the synthesized sulfonated complex polymer type which shall be added to concrete mixer at central batch plant or on site. Acceptable types: 'Rheobuild' by Master Builders Co Ltd. and 'PSP by Construction Chemicals Ltd.

.2 Forms: in addition to requirements of Division 3, comply with the following:

.1 Flat surfaces: surface of forms in contact with architectural concrete shall be plastic coated plywood of a type similar to 'Fin Form' as distributed by Thomas Canada Ltd. Minimum thickness: 18 mm.

.2 Flat Surfaces Scheduled for Exposed view Smooth Finish: Minimum 18 mm thick high density overlaid plywood to CSA O121 free from surface defects, boats, grain pattern, and durable under effects of weather, construction traffic and concrete placement. Acceptable products; 'CZ44' by Fletcher Challenge Canada Ltd. or 'Sylvaform' by MacMillan Bloedel Ltd. or 'Pourform 107' by Ainsworth Products Company Ltd. or 'Weldform' by Canweld Ltd.

.3 Circular Columns: Fibre forms of following types only to produce smooth surface without fins or lines of any kind, of uniform texture and appearance. Acceptable products; Burke 'SmoothTube' with PVC liner by Perma Tubes Ltd. or 'Roli-Permaform' with polystyrene liner, by Perma Tubes Ltd.

.4 Reglet Forms: Clear pine, sticker run, to dimensions detailed.

2.2 MIX DESIGN

.1 Design the mix in accordance with requirements of CAN/CSA-A23.1, complying with clauses 14 and 15 as applicable.

.2 Design mix for a slump which is the minimum necessary to ensure good placement and finishing of concrete. Do not design concrete with a slump in excess of 75 mm before addition of superplasticizer.

.3 Provide evidence acceptable to the inspection and testing company appointed that proposed mix proportions will produce specified quality of concrete.

.4 Adjust concrete mix proportions as necessary to maintain quality of concrete, to satisfaction of Consultant, without increase to the Contract Price.

.5 Provide an acceptable cement dispersing, water-reducing admixture in all concrete.

.6 Ensure that entrained air content of concrete is within range specified in Tables 7 and 8 of CAN/CSA-A23.1 for conditions of exposure given. For non-air entrained concrete, ensure that entrained air does not exceed 3%.

.7 In addition to water-reducing admixture, provide an air entraining agent in all concrete surfaces exposed to freeze-thaw conditions and/or action of road salt.

.8 Provide Architectural concrete of the following design:

Portland Cement	Type 10, grey or white as required to achieve colour range of approved sample.
Coarse Aggregate	19 mm crushed limestone
Fine Aggregate	Clean sand - consolidated sand and gravel Pigment
	Harcros '[...]' to a maximum 1.5% loading by weight
Air Content	5% minimum - 7% maximum
Water/cement ratio	0.48
Slump	50 mm maximum before the use of superplasticer; 150 mm after addition of superplasticer

.1 Take necessary precautions to maintain quality control of concrete used for architectural concrete and ensure continuity of cement and aggregates used from batch to batch. Keep operations uniform throughout.

.2 Stockpile cement for use on this project in manner to ensure absence of any deleterious substances or contaminants.

PART 3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 COORDINATION WITH FORMWORK TRADES

.1 Shop drawings showing tie hole layout and formwork joint layout to be approved by Consultant prior to fabrication.

.2 Give directions to work of Division 3 to ensure all formwork is constructed to ensure that finished concrete surfaces will be free from any imperfections as a result of, but not limited to, misalignment or warping of forms, misalignment or warping of plywood or steel elements, inadequate tightness of forms, mortar leakage and any texture imparted by formwork. Give directions to trades in establishing pattern of form ties. Apply silicone beads to all formwork joints to avoid mortar leakage.

.3 Where drawings do not show formwork layout joints, provide symmetrical architectural layout which relates to pronounced architectural building lines, grids and features such as columns and window mullions. Use maximum size formwork liner sheets commercially available. Obtain Consultant's approval of final joint locations.

.4 Provide double layer formwork for all architectural concrete, back all edges of plywood forms and brace for assurance that mortar leakage is eliminated.

Carefully inspect column forms prior to erecting to ensure debris has not intruded plane between liner and fibre outer covers, nor has entered formwork voids.

.5 Internal form ties are not permitted in formwork at beams, girders and columns.

.6 Water-resistant gaskets are required to seal form joints tight over previous pour.

.7 Ensure correct form ties have been used in which no metal is closer than 38 mm to surface of concrete, and form tie layout is in conformance with reviewed shop drawings.

3.3 PLACING OF CONCRETE

.1 Before commencement of erection procedures, examine form surfaces, location and alignment of component placed under Division 3. Report deficiencies to Consultant.

.2 At least 48 hours before concrete is placed notify Construction Manager or proposed date and time of commencement of concreting.

.3 Ensure curing and sealing materials are compatible with architectural finishes, and are non-staining, including adhesives that may be used.

.4 Conform to Division 3 and CAN/CSA -A23.1 fro placing and compaction of concrete and as hereinafter specified. Comply with details of clause 28 of CAN/CSA-A23.1, and further references to CSA A23.4 and CAN/CSA-S269.3 for formwork and casting.

.5 Between October 15th and April 15th of the following year and/or when the air temperature is below 5°C, place all concrete in accordance with requirements of CAN/CSA-A23.1 ‘Cold Weather Requirements’.

.6 Effect hot weather concreting in accordance with the requirements of CAN/CSA-A23.1 and ACI standard 305 ‘Recommended Practice for Hot Weather Concreting’.

.7 Thoroughly clean equipment used in conveying concrete after each run, discharge such cleaning water outside the forms.

.8 Thoroughly clean forms or steel deck. Before placing concrete, use wooden ploughs and compressed air free from lubricating oil and condensate, clean forms of all paper, plastic, metal and other debris with special form cleaning tools.

.9 Apply release agent to faces of formwork in one molecule thickness no greater than 12.5 µm.

.10 Prior to erecting column and wall formwork against cast concrete surfaces, clean such surfaces throughly; after erecting formwork, seal the form top opening to prevent accidental entry of foreign objects. Remove protection as casting starts.

.11 Approximately 12 hours before concrete is placed, re-tighten forms as is necessary, and saturate the surfaces of construction joints and form sides with water.

.12 Deposit concrete as close to it's final position as possible, and do not allow to flow laterally more than 600 mm. Maximum free drop of concrete; 1200 mm.

.13 For depositing concrete in beams, provide suitably sized , tapered pouring boxes to tunnel concrete into forms. Provide sufficient boxes for each pour such that they can be placed simultaneously at approximately 2000 mm OC for the entire length of the pour.

.14 Use pumping methods only for depositing of concrete into column forms.

.15 Arrange operations so that once a pour is started, concreting is carried on continuously, and the concrete at the surface of the pour is maintained plastic until completion of the section.

.16 Do not use calcium chloride or other chemicals to accelerate setting.

.17 To compact Architectural Concrete, use internal vibrators 25 to 50 mm diameter as required. Apply vibrators at sufficiently short intervals (approximately 500-1000 mm OC) that vibrated areas overlap without omission of any part. Ensure that the vibrators are inserted through the layer being compacted, but take care not to damage forms or form liners. Leave vibrator in place from 5 to 15 seconds, and withdraw slowly leaving the vibrator operating. Place architectural concrete in 300 mm layers; vibrate through two layers into the third layer.

.18 Shortly after concrete is placed and compacted to top of designated construction joints, rework concrete with wooden chisels at the exposed faces to a depth of at least 600 mm and then re-vibrate.

.19 Where excessive vibrating of concrete results in segregation of concrete elements, remove and replace with specified concrete as directed.

.20 Monitor concrete hydration temperatures closely with immersion thermometers set in water-filled holes in tops of beams and columns and keep accurate log for Consultant's periodic review.

.21 Place concrete n horizontal and vertical lifts as one continuous operation between construction joints. Make joints in walls at the top of Reglet, unless otherwise shown. Do not allow pour edges to set prior to placing adjacent concrete. Sequence placing operations to prevent concrete drying shrinkage.

.22 Concrete for each column and each beam shall be deposited from the same, single truck load.

.23 Exposed edges of tops of walls, beam soffits, column corners are designed as square corners without any type of radius. Take precautions in vibrating and form removal acceptable to Consultant to ensure clean, sharp, 90° corners. After form removal, hand rub corners to 3 mm radius.

.24 Should there be a chance of precipitation and forms be exposed ensure that once form release agent has been applied, forms are protected until the pour is complete.

3.4 CONSTRUCTION JOINTS

.1 Conform to CAN/CSA-A23.1 and as hereinafter specified.

.2 Provide vertical construction joints in walls at not more than 19 mm OC.

.3 Bond fresh concrete to hardened concrete to CAN/CSA-A23.1, clause 19.5, and where job conditions cause ‘cold-joint’ conditions to develop, resume casting over concrete surfaces having received coat of bonding or bond mortar. Ensure bonding material does not contaminate form surface or show in finished work.

.4 Provide a continuous shear key in construction joints in walls and spandrels 125 mm or more in thickness and ensure reinforcement continues uninterrupted through joint.

3.5 STRIPPING OF FORMWORK

.1 Further to requirements of CAN/CSA-A23.1 and Division 3, prior to formwork removal, ensure minimum concrete strength is 75% of specified strength and temperature differential between ambient and concrete mass is no greater than 30°C.

.2 Strip forms no later than 7 days after pouring. Once this duration has been established, strip all successive pours after the same amount of time.

.3 Carefully strip circular column forms when concrete has achieved 75% of it’s strength and immediately as directed for full height inspection, and replace over columns, strapping into position for protection.

3.6 CURING AND PROTECTION

.1 Cure and protect formed concrete surfaces a minimum of 3 days and to CAN/CSA- A23.1. Only burlap curing with constant water spray techniques is permitted for architectural concrete; see further requirements under Division 3.

.2 Prevent rapid drying at end of curing period.

.3 To protect Architectural Concrete, use polyethylene sheets or the like to prevent members from staining or becoming coated with leakage during concrete operations. Protect concrete surfaces from staining due to rusting of reinforcing steel and other metal hardware items.

.4 Job Site Protection of Cast and Finished Elements:

.1 Construct rigid wood and plywood boxing to be kept in place for the duration of on site construction of the entire project.

.2 Immediately after stripping, cover concrete with an air tight bonnet consisting of heavy polyethylene. Design protection to ensure finished work is free of any traces of staining, shipping or other defects.

.3 Protective devices shall allow free passage of air, and shall be tightly wrapped and sealed over a spacer system of plastic coated [hot dip galvanized] woven or welded wire mesh using heavy gauge polyethylene films. Provide closed cell synthetic or 'dimpled' plastic spacer pads between concrete and plywood; organic and metallic materials will not be allowed to make contact with architectural concrete surfaces.

.4 Wooden protective devices are required for all exposed architectural concrete surfaces located within 2400 mm of finished floor surfaces and for other areas subjected to possible damage by construction activities.

.5 Upon acceptance of protective devices by Consultant, continued inspections, modifications and maintenance of such devices shall be provided by work of Section 01 10 10.

3.7 FINISHES

.1 Standard Concrete Finish: Refer to Section 03 36 00 – Sandblasted Concrete Finish

3.8 SPECIAL CLEANING

.1 As late as possible prior to turning building over to Owner, clean exposed architectural concrete with fibre brushes, soap and water, then rinse with clean water, preferably from a hose. Streaks and stains on visible concrete are not permitted.

.2 Remove surplus materials and rubbish from Site at completion of Work.

3.9 INSPECTION AND TESTING

.1 Carry out in-shop testing of materials and maintain quality control in accordance with stated standards. Submit results of tests for review.

.2 Provide air entrainment checks on every 25 m^2 of concrete cast into formwork for exterior elements.

.3 Monitor concrete hydration temperature by casting or drilling holes in tops of concrete members as designated and placing water and immersion thermometers into such holes and covering with an adequate amount of insulation to keep water from freezing.

.4 Allow independent inspection and testing company access to fabrication shop in order to witness testing and fabrication operations in accordance with requirements of the Conditions of the Contract.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for sandblasted concrete finish Work. Work in accordance with the Contract Drawings.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-Place Concrete

.2 Section 03 33 00 – Architectural Concrete

1.3 QUALITY ASSURANCE

.1 Perform Work by a company that has a minimum of five years proven experience in sandblast concrete finish work on a project of a similar size and nature. Submit to Consultant substantiating information as proof of compliance.

1.4 MOCK-UP

.1 Section 01 45 00 – Quality Control:

.2 Construct mock-up area under conditions similar to those which will exist during actual placing, 3’-0”x 3’-0”, to demonstrate the degree of texture and exposure of aggregate specified has been obtained.

.3 Locate where directed.

.4 Mock-up may remain as part of the Work.

1.5 SITE CONDITIONS

.1 Do not commence sandblasting until concrete has properly and uniformly cured a minimum 28 days.

PART 2 Products

2.1 MATERIALS

.1 Abrasive: Hard, angular sand and blasting grit abrasive that will not adversely affect the colour of the finished surface. Grit gradation shall be selected by the Contractor to achieve the desired finish.

2.2 EQUIPMENT

.1 Provide safe and adequate equipment on the site to execute the work, hoisting, scaffolding, staging, enclosures to prevent spread of dust, safety protection equipment, tools, plant and other equipment required for the execution and completion of the work.

.2 Air compressors shall be rotary type and have ample capacity capable of providing, at each nozzle, not less than 640 KPa within 3000 mm of the nozzle.

.3 Air shall be free when tested in conformance with ASTM D4285.

.4 Gun nozzle shall be of the Venturi type, either tungsten carbide or norbide and have a minimum inside diameter of 8 mm. Nozzle shall have automatic cut-off for proper control by operator.

.5 Hose lines shall be capable of dissipating static electricity and have adequate strength for the specified pressure. inside diameter of hose shall not be less than 40 mm to maintain abrasive in proper suspension while travelling in the hose.

PART 3 Execution

3.1 PREPARATION

.1 Protect surrounding and adjoining work by adequately covering with tarpaulins or other suitable protective covering. Enclose each work area with suitable tarpaulins or other tarpaulins to confine the dust and grit within the work area and prevent spread to adjoining areas. Make good all damage caused by failure to provide suitable and adequate protection and be fully responsible for any damage of claims resulting from this operation.

.2 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section.

.3 Suitably mask and protect from damage all inserts and other materials placed in position before the work of this section is performed.

.4 Fill all bug holes larger than 20 mm diameter and rub down flush any fins at formwork joints.

3.2 SANDBLASTED CONCRETE FINISH

.1 Do not proceed until sample panel has been approved.

.2 Sandblasting will only be permitted when surfaces being sandblasted are dry.

.3 Execute the work using the required gun technique, proceeding progressively over the entire area being finished to product a uniform even texture throughout with the same degree of aggregate exposure as that of the approved sample.

.4 Class of aggregate exposure may be defined as follows:

.1 Light sandblast: Exposes additional fine aggregate and possible edges of some course aggregate.

.5 Sandblast surfaces exposed to view with hard sharp sand until aggregate is exposed to a depth of 1.6 mm to a uniform constant relief.

.6 The approximate depths of exposure are measured from the original surface to the typical depth of surface material removed between pieces of coarse aggregate.

3.3 CLEANING

.1 Remove and dispose of all debris resulting from the work of this Section as the work proceeds, leaving work areas broom clean at the end of each day.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Design, labour, Products, equipment and services necessary for precast concrete specialties Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 ASTM C920, Specification for Elastomeric Joint Sealants.

.2 CAN/CSA-A23.1/A23.2, Concrete Materials & Methods of Concrete Construction / Methods of Test for Concrete.

.3 CSA-A23.3, Design of Concrete Structures.

.4 CSA A23.4, Precast Concrete-Materials and Construction.

.5 CAN/CSA-A231.1, Precast Concrete Paving Slabs.

.6 CSA A251-M, Qualification Code for Manufacturers of Architectural and Structural Precast Concrete.

.7 CAN/CSA G30.18-M, Billet-Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

.1 Section 01 33 00 – Submittal Procedures.

.2 Samples: Submit 600 x 600 mm samples in accordance with Section 01 33 00 showing each type, finish, and colour of precast architectural concrete finish. Demonstrate maximum colour variation.

1.4 MAINTENANCE DATA

.1 Section 01 78 10 – Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in precast architectural Work of comparable complexity and scope, to perform following services as part of Work of this Section:

.1 Structural design to accommodate live, dead, lateral, thermal, wind, seismic, handling, transportation, and erection loads.

.2 Review, stamp, and sign fabrication and erection shop drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, protect, and handle products to site to Section 01 61 00 – Product Requirements.

.2 Deliver materials in manufacturer's packaging including application instructions..

PART 2 Products

2.1 MATERIALS

.1 In this article, list the manufacturers acceptable for this project. If product substitution is allowed, include the last paragraph..

.2 General: Use materials specified in CSA A23.1 and CSA A23.3 and in conformance to those standards, modified as specified in this Section, and as required to meet specified performance.

.3 Water: Verify that no salts are present that will cause efflorescence.

.4 Reinforcing Steel: To meet specified requirements of CSA G30.18-M, epoxy coated.

.5 Flexible setting compound: ‘Planicrete W’ by Mapei.

.6 Sealant: ASTM C920, Type S, Grade NS, Class 100/50; One-part, low-modulus, moisture-curing, silicone. ‘Dow Corning 790' by Dow Corning; ‘Spectrem 1' by Tremco, Colour: as selected by Consultant.

.7 Flexible Flashing: Reinforced PVC, 20 mil thick, F-20 with adhesive and edge sealant by Lexsuco Canada Limited, Rexdale, Ontario.

.8 Adhesive: epoxy adhesive; ‘Latapoxy 300 Adhesive’ by Laticrete or approved alternative.

.9 Metal stairs: In accordance with Section 05 50 00.

2.2 FABRICATION

.1 Fabricate precast units to meet specified requirements of CSA A23.3 and CSA A23.4. Finish Grade A. Ensure that finished dimensions are within specified tolerances.

.2 Consolidate concrete through full cross-section of units to provide full bond with reinforcement. Surfaces shall be free of cold joints and honeycombing and with surfaces of a uniform appearance where exposed to view.

.3 Formwork:

.1 Construct forms to maintain precast units within their specified tolerances.

.2 Secure attached anchorage devices to formwork in locations not affecting position of main reinforcement or placing of concrete.

.3 Build forms to match custom sizes (various) of precast elements in accordance with Architectural Drawings.

.4 Reinforcement: Cover reinforcement with a minimum of 19 mm of concrete.

.5 Concrete: Of mix designed by fabricator to meet requirements of Specification

.1 Normal weight, with compressive strength of 38 MPa at 28 days.

.2 Consolidate placed concrete by vibration without dislocation or damage to reinforcement and built-in items.

.3 All exposed surfaces of precast units shall have an acid etched finish. Face mix shall be made up using limestone aggregate, concrete sand, and 100% Medusa White cement. Units will be rejected where backup concrete mix shows through face mix.

.4 Concrete mixture and colour to match polished concrete floors.

.6 Curing: Cure precast units in accordance with CSA A251-M, normal curing.

2.3 SOURCE QUALITY CONTROL

.1 Fabrication Tolerances:

.1 Width or thickness, plus or minus 3 mm.

.2 Length, plus or minus 6 mm.

.3 Warpage not to exceed span divided by 360.

PART 3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Defective work resulting from incorporation in unsatisfactory work previously completed will be considered the responsibility of those performing the work of this Section.

3.2 INSTALLATION

.1 Fit and align precast concrete units straight, plumb, level, and square with uniform joint widths. Cumulative dimensional error in positioning precast units will not be allowed.

.2 Adhere precast concrete to metal stairs in accordance with adhesive manufacturer’s written instructions.

.3 Fastening: Fasten precast units in place with full mortar bed and non-ferrous anchoring devices. Rake out mortar joints, for caulking.

.4 Do not install chipped, cracked, blemished, stained, or otherwise defective units.

.5 Apply required setting compound between precast stair treads and metal stair construction in accordance with manufacturer's written instructions.

.6 Caulk between abutting precast units and at joints between precast units and adjoining construction to meet specified requirements of Section 07 92 00 of this Specification.

.7 Site Tolerances: Joint dimension nominal 9 mm; to vary not more than 6 mm to 12mm. Erection tolerances shall be non-cumulative.

3.3 REPAIR

.1 Repair damaged and defective precast units which have not been rejected by the Consultant. Submit to the Consultant for approval, the method and materials to be used for repair work.

.2 Finish patches to match precisely the colour and texture of adjacent area. Remove and repatch areas that do not match.

.3 Secure patch to concrete surfaces with a bonding agent in accordance with manufacturer's directions.

.4 Cut off lifting devices from precast units and patch recesses with grout.

3.4 CLEANING

.1 Before cleaning soiled precast architectural concrete surfaces obtain Consultant's review and acceptance of cleaning methods.

.2 Clean soiled precast architectural concrete surfaces and replace elements not acceptable to Consultant.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Mortar materials.

.2 Mortar mixes.

1.2 RELATED SECTIONS

.1 Section 01 35 91 – Restoration Project Procedures.

1.3 REFERENCES

.1 ASTM C144-11 - Standard Specification for Aggregate for Masonry Mortar.

.2 ASTM C150/C150M-12 - Standard Specification for Portland Cement.

.3 ASTM C207-06(2011) - Standard Specification for Hydrated Lime for Masonry Purposes.

.4 ASTM C1324-10 - Standard Test Method for Examination and Analysis of Hardened Masonry Mortar.

.5 CAN/CSA-A179-04 (R2009) - Mortar and Grout for Unit Masonry.

.6 CAN/CSA-A3000-08 - Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.7 ASTM C1324-10 - Standard Test Method for Examination and Analysis of Hardened Masonry Mortar.

1.4 SUBMITTALS

.1 Section 01 35 91 – Restoration Project Procedures.

.2 Samples: Submit two (2) cured mortar samples, 6 x 1/2 x 1/2 inches in size for each mortar type.

.3 Samples will be compared to existing, clean sample to determine acceptability of match.

.4 Submit Product Data Sheets for each mortar type and associated MSDS sheets.

1.5 DELIVERY, STORAGE, AND PROTECTION

.1 Protect materials from moisture absorption and damage; reject damaged containers.

.2 Store sand to prevent inclusion of foreign matter.

Part 2 Products

2.1 MATERIALS

.1 Use same manufacturer, brands and suppliers for sources of mortar materials for entire project.

.2 Water: potable, clean, and free from deleterious amounts of acids, alkali, and organic matter.

.3 It is strictly forbidden to use any type of additive to modify the setting time, workability, fluidity or any other property of mortars and grouts, in the plastic or hardened state.

.4 **Premixed Mortar**: Premixed restoration mortars by the following manufacturer are to be used provided requirements of Contract Documents and manufacturer's requirements are met:

.1 Mortar Types:

.1 **Type A**: Mortar for rebuilding / setting stone:

.1 King Packaged Materials Company: HLM 500, Hydraulic Lime Mortar, colour to match existing (colour and aggregate size to be determined via site mock-ups to match existing).

2.2 MIXING MORTAR

.1 For premixed mortars, raw materials are mixed at the factory then kneaded with water on the job site following the manufacturer’s written instruction.

.2 Thoroughly mix ingredients in quantities needed for immediate use.

.3 Mix dry ingredients mechanically until uniformly distributed; add water to achieve workable consistency.

.4 Discard lumpy, caked, frozen, and hardened mixes, and mixes not used within 2 hours after initial mixing.

.5 Use mortar within 2-1/2 hours after initial mixing at ambient temperatures below 27 degrees C / 80 degrees F. and within 1-1/2 hours after initial mixing at ambient temperatures over 27 degrees C / 80 degrees F or as per manufacturer’s written instructions.

.6 Do not add antifreeze compounds to lower freezing temperature of mortar.

.7 Provide consistent colour for exposed mortar.

Part 3 Execution

3.1 INSTALLATION

.1 Install mortar to area indicated on drawings.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-Place Concrete

.2 Section 04 05 13 - Masonry Mortar and Grout

.3 Section 04 05 19 - Masonry Anchorage and Reinforcing

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CAN/CSA-A165 Series-14, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371-14, Masonry Construction for Buildings.

.2 International Masonry Industry All-Weather Council (IMIAC)

.1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Preinstallation meetings: comply with 01 31 19 - Project Meetings. Conduct preinstallation meeting one week before commencing work of this Section to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Coordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Coordinate with other building subtrades.

.6 Review manufacturer's installation instructions.

.7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.

.8 Review warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.

.4 Test and Evaluation Reports:

.1 Submit certified test reports in accordance with Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

.2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.

.3 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.

.5 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

.6 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:

.1 Verification of compliance of work with Contract.

.2 Site visit reports providing detailed review of installation of work, and installed work.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect material packages from nicks, scratches, and blemishes.

.3 Keep materials dry until use except where wetting of bricks is specified.

.4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

.5 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

.1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.

.2 Weather Requirements: CAN/CSA-A371 and Recommended Practices and Guide Specifications for Cold Weather Masonry Construction and CAN/CSA S304.

.3 Hot weather requirements to CAN/CSA-A371

.4 Cold weather requirements to CAN/CSA-A371

Part 2 Products

2.1 MATERIALS

.1 Masonry materials are specified elsewhere in related Sections:

.1 Section 04 20 00 Unit Masonry.

Part 3 Execution

3.1 INSTALLERS

.1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.

.1 Coordinate with Section 01 71 00 - Examination and Preparation.

.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.

.1 Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions have been remedied.

.3 Verification of Conditions:

.1 Verify that:

.1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions before installation of concrete block.

.2 Site conditions are acceptable and are ready to receive work.

.3 Built-in items are in proper location, and ready for roughing into masonry work.

.2 Commencing installation means acceptance of existing substrates.

3.3 PREPARATION

.1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and coordinate with Section 01 71 00 - Examination and Preparation.

.2 Establish and protect lines, levels, and coursing.

.3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

.1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

.1 Exposed masonry:

.1 Remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165, in exposed masonry and replace with undamaged units.

.2 Jointing:

.1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.

.2 Allow joints to set just enough to remove excess water, then rake joints uniformly to 6 mm depth and compress with square tool to provide smooth, compressed, raked joints of uniform depth where raked joints are indicated.

.3 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.

.3 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.4 Building-In:

.1 Build in items required built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

.5 Wetting of bricks:

.1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm^2: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.

.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

.6 Support of loads:

.1 Use grout to CAN/CSA-A179 where grout is used instead of solid units

.2 Install building paper below voids to be filled with grout; keep paper 25 mm back from faces of units.

.7 Provision for movement:

.1 Leave 3 mm space below shelf angles.

.2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.3 Built masonry to tie in with stabilizers, with provision for vertical movement.

.8 Loose steel lintels:

.1 Install loose steel lintels. Center over opening width.

.9 Control joints:

.1 Construct continuous control joints as indicated.

.10 Movement joints:

.1 Build-in continuous movement joints as indicated.

.11 Interface with other work:

.1 Cut openings in existing work as indicated.

.2 Openings in walls: approved by Consultant.

.3 Make good existing work. Use materials to match existing.

3.6 SITE TOLERANCES

.1 Tolerances in notes to CAN/CSA-A371 apply

3.7 SITE QUALITY CONTROL

.1 Site Tests, Inspection:

.1 Perform site inspection and testing in accordance with Section 01 45 00 - Quality Control.

.2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

.2 Manufacturer's Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection of its products, and submit written reports in acceptable format to verify compliance of work with Contract.

.2 Manufacturer's site services: provide manufacturer's site services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work as installation is about to begin.

.4 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

.5 Obtain reports within 3 days of review and submit immediately to Consultant.

3.8 PROTECTION

.1 Temporary Bracing:

.1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

.2 Bracing approved by Consultant.

.3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 Moisture Protection:

.1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.

.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

.3 Air Temperature Protection: protect completed masonry as recommended in 1.9, SITE CONDITIONS.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Grout for masonry.

.2 Mortar for masonry.

1.2 RELATED REQUIREMENTS

.1 Section 04 05 19 - Masonry Anchorage and Reinforcing

1.3 REFERENCE STANDARDS

.1 CAN/CSA A179-14 Mortar and grout for unit masonry

.2 CAN/CSA A371-14 Masonry construction for buildings

.3 STD S304-14 Design of masonry structures

1.4 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Include design mix, indicate whether the Proportion or Property specification of CAN/CSA-A179 is to be used, required environmental conditions, and admixture limitations.

.3 Samples: Submit two (2) samples of mortar, illustrating mortar colour and colour range.

1.5 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Reports:

.1 Submit reports on mortar indicating conformance of mortar to property requirements of CAN/CSA-A179.

.2 Submit reports on grout indicating conformance of component grout materials to requirements of CAN/CSA-A179.

.3 Installation Data: Manufacturer's special installation requirements for premix mortar or premixed grout.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.7 SITE CONDITIONS

.1 Cold and Hot Weather Requirements: CAN/CSA-A371.

Part 2 Products

2.1 MATERIALS

.1 Cementitious Material:

.1 Portland Cement: CSA-A3000, Type GU, colour grey.

.2 Masonry Cement: CSA-A3000, Type S, colour grey.

.3 Mortar Cement: CSA-A3000.

.4 Blended Hydraulic Cement: CSA-A3000.

.2 Mortar Aggregate: CAN/CSA-A179, fine aggregate.

.3 Grout Aggregate: CAN/CSA-A179, fine aggregate.

.4 Water: Clean and potable.

.5 Premix Mortar: CAN/CSA-A179, Type S, using grey colour cement. with a minimum compressive strength of 8.5MPa

2.2 MORTAR MIXES

.1 Mortar for Exterior Above Grade:

.1 Loadbearing Walls: CAN/CSA-A179, Type S with a minimum 28 day compressive strength of 8.5MPa.

.2 Non-Loadbearing Walls: CAN/CSA-A179, Type S with a minimum 28 day compressive strength of 8.5MPa..

.2 Mortar for Interior Above Grade:

.1 Loadbearing Walls: CAN/CSA-A179, Type S with a minimum 28 day compressive strength of 8.5MPa.

.2 Non-Loadbearing Partitions: Type S with a minimum 28 day compressive strength of 8.5MPa.

2.3 MORTAR MIXING

.1 Mix mortar ingredients to CAN/CSA-A179 in quantities needed for immediate use.

.2 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.

.3 If moisture is lost by evaporation, retemper as directed by the manufacturer.

.4 Use mortar within period and temperatures as specified in CAN/CSA-A179.

2.4 GROUT MIXES

.1 Engineered Masonry: 10 MPa (minimum) strength at 28 days for fine grout and 12.5 MPa (minimum) for coarse grout.

2.5 GROUT MIXING

.1 Mix grout to CAN/CSA-A179.

.2 Thoroughly mix grout ingredients in quantities needed for immediate use to CAN/CSA-A179, fine and coarse grout.

.3 Add admixtures into manufacturer's written instructions; mix uniformly.

.4 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

.2 Request inspection of spaces to be grouted.

3.2 PREPARATION

.1 Apply bonding agent to existing concrete surfaces.

.2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 INSTALLATION

.1 Install mortar and grout to CAN/CSA-A179.

.2 Install mortar and grout to manufacturer's written instructions and as specified in Section 04 05 19.

.3 Filling blocks units with mortar instead of grout is not acceptable

.4 Where note is made to fill masonry solid, all cores shall be filled solid from the bearing point down to the footings with grout.

.5 All masonry installed above roof deck elevation or below grade shall be grouted 100% solid.

3.4 FIELD QUALITY CONTROL

.1 Inspection and Testing:

.1 Section 01 45 00: Test mortar and grout.

.2 Test mortar mix to CAN/CSA-A179 and CAN/CSA S304.1 for compressive strength. Provide three sets of tests.

.3 Test grout mix to CAN/CSA-A179 and CAN/CSA S304.1 for compressive strength. Provide three sets of tests.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Continuous wire reinforcement and reinforcing rods.

.2 Masonry anchors and ties.

1.2 RELATED REQUIREMENTS

.1 Section 04 05 10 - Masonry Mortar and Grout

.2 Section 04 05 00 - Common Work Results for Masonry

.3 Section 04 20 00 - Unit Masonry

1.3 REFERENCE STANDARDS

.1 CSA A23.1:19/A23.2:19 Concrete materials and methods of concrete construction/test methods and standard practices for concrete

.2 STD G40.20/G40.21-13 General requirements for rolled or welded structural quality steel/structural quality steel

.3 CSA A370:14 Connectors for masonry

.4 CAN/CSA A371-14 Masonry construction for buildings

.5 STD S304-14 Design of masonry structures

1.4 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

Part 2 Products

2.1 MATERIALS

.1 Steel Bars, Bars, Plates, Angles: CSA-G40.20/G40.21, Grade 300W.

.2 Bolted connection shall be made using Grade A325 bolts, unless noted otherwise.

.3 Anchor rods shall conform to ATSM F1554 (formerly ASTM A307). Material shall be grade 36 (Fu = 414 MPa) (Formerly ASTM A307 Grade C), or CSA G40.21 300W (Fu = 450MPa).

2.2 MASONRY CONNECTORS

.1 Single Wythe Joint Reinforcement: CAN/CSA-A370, continuous Ladder type reinforcing, 3.66mm (9 ga.).

.1 Reinforce all masonry with ladder reinforcing at 600 mm (24") o.c. except where noted otherwise. Full overlap at the wall intersections and corners. Lap straight runs with 300mm (12") overlap.

.2 Rod Anchors: CAN/CSA-A370, formed steel rods, adjustable, hot dip galvanized to ASTM A123/A123M after fabrication, 13 mm thick.

.3 Bar Reinforcing Steel: CSA-G30.18, Grade 400W, deformed billet bars, uncoated finish.

.4 Hardware and Bolts: Hot dip galvanized to ASTM A153/A153M after fabrication.

2.3 FABRICATION

.1 Fabricate connectors to CAN/CSA-A370.

.2 Fabricate bar reinforcing to CSA-A23.1/A23.2.

Part 3 Execution

3.1 INSTALLATION

.1 Install anchors and reinforcing as indicated in Section 04 26 16 Reinforced Unit Masonry

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Concrete Masonry Units:

.1 Concrete block units.

1.2 RELATED REQUIREMENTS

.1 Section 04 05 13 - Mortar And Masonry Grout.

.2 Section 04 05 19 - Masonry Anchorage and Reinforcement.

1.3 REFERENCE STANDARDS

.1 STD A165 SERIES-14 CSA Standards on concrete masonry units

.2 CAN/CSA A371-14 Masonry construction for buildings

.3 STD S304-14 Design of masonry structures

1.4 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

Part 2 Products

2.1 CONCRETE BLOCK MASONRY UNITS

.1 Concrete Block Masonry Units (CMU): CAN/CSA-A165, CAN/CSA S304.1 "Design of Masonry Structures" and CAN/CSA-A371 "Masonry Construction for Buildings"

.1 Concrete blocks shall be regular weight, 50% solid, with a minimum of 15MPa compressive strength, U.N.O.

Part 3 Execution - Not Used

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Common work results for reinforced unit masonry construction.

1.2 RELATED REQUIREMENTS

.1 Section 04 05 10 - Mortar and Masonry Grout: Mortar and grout.

.2 Section 04 05 19 - Masonry Anchorage and Reinforcement: Connectors and reinforcing.

.3 Section 04 20 00 - Masonry Units: Unit masonry materials.

.4 Section 05 50 00 - Metal Fabrications: Loose steel lintels and fabricated steel items.

1.3 REFERENCE STANDARDS

.1 CSA A370:14 Connectors for masonry

.2 CAN/CSA A371-14 Masonry construction for buildings

.3 STD S304-14 Design of masonry structures

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Section 01 31 00: Project management and coordination procedures.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Coordinate the masonry work with installation of structural steel and elevator.

.3 Pre-installation Meetings: Convene one (1) week before starting work of this section. Masonry contractor, engineer and general contractor to meet to review control joints, method of grouting and bar locations.

1.5 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide data for concrete masonry units and fabricated wire reinforcement.

.3 Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement and accessories.

1.6 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Design Data: Indicate required mortar strength, masonry unit assembly strength in all planes, supportive test data.

1.7 QUALITY ASSURANCE

.1 Perform Work to CSA-S304 and CAN/CSA-A371. Maintain one (1) copy of document on site.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Deliver, store, protect and handle products to site.

.2 Package and protect masonry units to arrive undamaged at the job site.

.3 Store masonry under waterproof cover on pallets or plank platforms held off ground.

1.9 SITE CONDITIONS

.1 Cold and Hot Weather Requirements: CAN/CSA-A371.

Part 2 Products

2.1 CONCRETE BLOCK MASONRY UNITS

.1 Concrete Block Units (CMU): Specified in Section 04 20 00.

2.2 REINFORCEMENT AND ANCHORAGE

.1 Joint Reinforcement: As Specified in Section 04 05 19.

.2 Bar Reinforcing Steel: As Specified in Section 04 05 19.

.3 Bar and Rod Anchors: As Specified in Section 04 05 19.

.4 Steel Angles: Specified in Section 05 50 00.

2.3 MORTAR AND GROUT

.1 Mortar and Grout: Type as specified in Section 04 05 10.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that field conditions are acceptable and are ready to receive work.

.2 Verify items provided by other sections of work are properly sized and located.

.3 Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

.1 Direct and coordinate placement of metal anchors supplied to other Sections.

.2 Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

.3 Verify that items built-in under other sections are properly located and sized.

3.3 COURSING

.1 Build masonry plumb, level, and true to line, with vertical joints in alignment.

.2 Establish lines, levels, and coursing indicated. Protect from displacement.

.3 Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

.4 Concrete Masonry Units:

.1 Bond: Running.

.2 Coursing: One (1) unit and one (1) mortar joint to equal 200 mm.

.3 Mortar Joints: Flush.

3.4 PLACING AND BONDING

.1 Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

.2 Lay hollow masonry units with face shell bedding on head and bed joints.

.3 Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

.4 Remove excess mortar as work progresses.

.5 Interlock intersections and external corners.

.1 Key all masonry joints at wall corners and intersections. Rake back wall construction when turning wall corners.

.2 Provide 38mm x 4.8mm (1 1/2" x 3/16") masonry strap at every second course tying block walls to adjoining concrete walls and structural steel.

.6 Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

.7 Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

.8 Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

3.5 PROVISION FOR MOVEMENT

.1 Leave deflection space between top of non-loadbearing wall and structural elements. Do not use wedges.

3.6 REINFORCEMENT AND ANCHORAGE

.1 Install masonry connectors and reinforcement to CAN/CSA-A370, CAN/CSA-A371 and CSA-S304.1 and as indicated on the structural Drawings.

.2 Place joint reinforcement spaced as follows:

.1 To CAN/CSA-A371.

.2 At 600 mm or 24 inches.

.3 For stack bond joint install joint and corner reinforcing at every course.

.4 Lap joint reinforcement ends minimum 12".

.5 Reinforce and grout masonry units and bond beams to CAN/CSA-A371.

.6 Install vertical reinforcing steel with a minimum clearance of 1/2 inch from the masonry and not less than one bar diameter between bars.

.7 Secure reinforcing steel in place. Inspect steel connections before grouting.

.8 Provide cleanout openings at bottom of cores containing reinforcement.

.9 Fill cells containing reinforcement and anchor bolts solidly with grout.

.10 Grout masonry solid below all lintel ends and point loads for wall cores beneath bearing points. For openings exceeding 500mm (20"), in the first full height core adjacent to all bearing points, install 1-15M bar and grout full height.

.11 Where masonry bears on steel beams, weld 15M x 300mm (12") long weldable rebar dowels at 1200mm (48") o.c. to all beams.

3.7 LINTELS

.1 Install loose steel lintels, centred over openings.

.2 Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled, to CAN/CSA-A371 and CSA-S304.

.3 Maintain minimum 200mm (8") bearing on each side of opening.

3.8 LATERAL SUPPORT AND ANCHORAGE

.1 Install lateral support and anchorage as indicated.

3.9 SUPPORT OF LOADS

.1 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.

.2 Install building paper below voids to be filled with grout; keep paper 1 inch back from face of units.

3.10 ENGINEERED MASONRY

.1 Lay masonry units with core cells vertically aligned clear of mortar and unobstructed.

.2 Reinforce masonry unit cavities with reinforcement bars and grout to CAN/CSA-A371 and CSA-S304.

3.11 MOVEMENT JOINTS

.1 Provide continuous control joints as indicated.

.2 Do not continue horizontal joint reinforcement through expansion joints.

.3 Break vertical mortar bond with sheet building paper fitted to one side of the hollow contour end of the block unit. Fill the resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

.4 Install preformed control joint device in continuous lengths. Seal butt and corner joints to manufacturer's written instructions.

.5 Size control joint as specified in Section 07 92 00 for sealant performance.

.6 Form expansion joint as detailed.

.7 Vertical control joints shall be installed in all walls at 7.6m (25'-0") o.c. maximum. U.N.O.. Reinforcing shall not cross a construction joint. Carefully locate all control

joints. Do not install vertical control joint through bond beams or tension/compression chords; instead stop the control joint below & above the bond beam and run bond beam rebar through.

3.12 BUILT-IN WORK

.1 As work progresses, install built-in anchor bolts and plates and other items to be built-in the work and furnished by other sections.

.2 Install built-in items plumb and level.

.3 Bed anchors of frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 300mm (12") from framed openings.

.4 Do not build in organic materials subject to deterioration.

3.13 ERECTION TOLERANCES

.1 Section 01 73 00: Tolerances.

.2 Tolerances for unit masonry as recommended in CAN/CSA-A371.

.3 Vertical Alignment: Maximum deviation from plumb, 19 mm / 3/4 inch over height of building for walls and columns, edges and corners, movement joints, and head joints.

.4 Lateral Alignment: Maximum deviation from gridline, 13 mm / 1/2 inch for constructed unit masonry surfaces of walls and columns.

.5 Level Alignment: Maximum deviation for exposed horizontal surfaces, bed joints and bearing surfaces 13 mm / 1/2 inch; unexposed horizontal surfaces 25 mm / 1 inch.

.6 Relative Alignment: Maximum deviation 6 mm in 3 m / 1/4 inch in 10 ft.

3.14 CUTTING AND FITTING

.1 Cut neatly for electrical switches, outlet boxes and other recessed or built-in objects. Coordinate with other sections of work to provide correct size, shape, and location.

.2 Make cuts straight, clean and free of uneven edges.

.3 Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 FIELD QUALITY CONTROL

.1 Inspection and Testing:

.1 Section 01 45 00: Field inspection and testing.

.2 Inspect all engineered masonry work.

3.16 CLEANING

.1 Section 01 74 10: Cleaning installed work.

.2 Remove excess mortar and mortar smears as work progresses.

.3 Replace defective mortar. Match adjacent work.

.4 Clean soiled surfaces with cleaning solution.

.5 Use non-metallic tools in cleaning operations.

3.17 PROTECTION

.1 Section 01 78 23: Protecting installed work.

.2 Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Structural steel framing members, support members.

.2 Base plates, bearing plates.

.3 Grouting under base plates.

1.2 RELATED REQUIREMENTS

.1 Section 05 31 13 - Steel Floor Decking: Support framing for small openings in floor deck.

.2 Section 05 31 23 - Steel Roof Decking: Support framing for small openings in roof deck.

.3 Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

.4 Section 04 05 19 - Masonry Anchorage and Reinforcement: Supply of anchors for casting into concrete and anchoring into masonry

1.3 DEFINITIONS

.1 Delegated Design Professional: The specialist or supporting design professional contracted to the contractor, fabricator or manufacturer to design and/or review specific building components or sub-components, and provide Shop Drawings and Delegated Design Submittals to meet the requirements of authorities having jurisdiction.

1.4 REFERENCE STANDARDS

.1 STD G40.20/G40.21-13 General requirements for rolled or welded structural quality steel/structural quality steel

.2 CSA S16:19 Design of steel structures

.3 Handbook of steel construction

.4 CSA W47.1:19 Certification of companies for fusion welding of steel

.5 STD W59-18 Welded steel construction

.6 Maintenance repainting specification manual

1.5 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Shop Drawings:

.1 Indicate profiles, sizes, spacing, locations of structural members, openings, attachments and fastening.

.2 Connections.

.3 loads.

.4 Indicate welded connections with AWS A2.1-DC welding symbols. Indicate net weld lengths.

.5 Provide structural steel shop drawings / erection drawings stamped by a professional engineer licensed in Ontario. Stamp for connections only.

.1 Connections shall be concentric and shall not introduce eccentricity into any elements.

.2 Design of steel connections to the maximum UDL loads in steel handbook beam tables, provided no point loads act on the beam and when shears are not indicated

1.6 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Manufacturer's Mill Certificate: Certify that Products meet or exceed specified requirements.

.3 Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.

.4 Delegated Design Submittals:

.1 Submit documentation indicating compliance to design criteria, signed and sealed by the delegated design professional responsible for their preparation.

.1 Design Data: Include material data, calculations and details.

1.7 QUALITY ASSURANCE

.1 Fabricate structural steel members to CISC Code of Standard Practice, and CSA-W59.

.2 Perform Work to AISC Section 10. Maintain one (1) copy of document on site.

.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

.4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

.5 Delegated Design Professional Qualifications: Professional Structural Engineer experienced in design of this Work and licensed in the province where the project is located.

.6 Welders' Certificates: Submit to Section 01 33 00, certifying welders employed on the Work, verifying qualification within the previous twelve (12 months) to CSA-W59 and CSA-W47.1.

Part 2 Products

2.1 PERFORMANCE / DESIGN CRITERIA

.1 Delegated Design: Design structural steel connections by a licensed design professional using performance and design criteria as indicated.

2.2 MATERIALS

.1 Structural Steel Beam and Columns: ASTM A992/992M, Grade 50 (Fy = 345 MPa) unless otherwise noted.

.2 Structural Channels and Angles: CSA-G40.20/G40.21, Grade 300W unless otherwise noted.

.3 H.S.S.: CSA-G40.20/G40.21, Grade 350W (Class C) unless otherwise noted.

.4 Steel plate.: A36, Grade 250W minimum unless otherwise noted.

.5 Bolts, Nuts, and Washers: ASTM A325 bolts, galvanized to A153/A153M for galvanized structural members.

.6 Anchor Bolts: ASTM F1554 (formerly ASTM A307). Material shall be a minimum of Grade 36 (Fu = 414MPa) or CSA G40.21 300W (Fu=450MPa)..

.7 Welding shall conform to CSA W47.1 and CSA W59, by the Canadian Welding Bureau. All welding shall be completed by CWB Certified Welders. Third party welding inspection shall be performed by firms certified to CSA W178.1 and W178.2.

.8 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, with a compressive strength of 35 MPa (minimum). Grout shall be installed at a maximum of 38mm (1 1/2").

.9 Primer: As specified in Section 09 91 00.

2.3 FABRICATION

.1 Fabricate structural steel to CSA-S16 and in accordance with reviewed Shop Drawings.

.2 Continuously seal joined members by continuous welds. Grind exposed welds smooth.

.3 Fabricate connections for bolt, nut, and washer connectors.

.4 Where masonry bears on steel beams, weld 15M x 300mm (12") long weldable rebar dowels at 1200mm (48") o.c. to beams

2.4 FINISH

.1 Clean, prepare surfaces, and shop prime structural members to CSA-S16, except as noted below.

.2 Shop prime structural steel members. Do not prime surfaces that will be fireproofed.

.3 Hot-dip galvanized to ASTM A123/A123M, zinc coating thickness appropriate grade for type and size of steel material indicated.

.4 All structural steel shall receive a minimum of one coat of approved shop primer, touched up as required on site, except that steel which will receive spray-on fireproofing shall not be primed.

.5 Galvanizing for metals shall conform with CSA-G164 unless noted. Touch-up on site by grinding the surface to bright metal and applying zinc rich paint conforming to CAN/CGSB-1.181 (or ASTM A780).

.6 Exterior structural steel shall be protected from corrosion by hot dip galvanizing. Exterior HSS columns shall have drainage holes at the base (13mm (1/2") dia. max 2" from the base).

2.5 SOURCE QUALITY CONTROL AND TESTS

.1 Provide shop testing of structural steel sections.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

3.2 ERECTION

.1 Erect structural members to CSA-S16.

.2 Perform welding: CSA-W59.

.3 Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

.4 Field weld components indicated on Drawings and Shop Drawings.

.5 Do not field cut or alter structural members without approval of Consultant.

.6 After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

.7 Grout under base plates as specified on structural drawings. Trowel grouted surface smooth, splay neatly to 45 degrees.

.8 Field Painting - Touch-Up:

.1 Paint to requirements of Section 09 91 00.

.2 Touch up all damaged surfaces and exposed surfaces without shop coat, with primer.

.9 Structural steel shall be tested by an independent C.S.A. certified testing company for erection tollerances, plumbness, alignment, connections, elevation, materials and workmanship. Provide stamped structural steel inspection report to consultant team.

3.3 ERECTION TOLERANCES

.1 Section 01 73 00: Tolerances.

3.4 FIELD QUALITY CONTROL

.1 Inspection and Testing:

.1 Section 01 45 00: Field inspection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Steel floor deck and accessories.

.2 Formed steel deck end forms to contain wet concrete.

.3 Bearing plates and angles.

1.2 RELATED REQUIREMENTS

.1 Section 03 20 00 - Concrete Reinforcing.

.2 Section 03 30 00 - Cast-in-place Concrete: Concrete topping over metal floor deck.

.3 Section 05 31 23 - Steel Roof Decking.

.4 Section 03 30 00 – Cast-In-Place Concrete: Placement of anchors for bearing plates and angles cast in concrete.

.5 Section 04 29 00 - Reinforced Unit Masonry: Placement of anchors for bearing plates and angles embedded in masonry.

1.3 DEFINITIONS

.1 Delegated Design Professional: The specialist or supporting design professional contracted to the contractor, fabricator or manufacturer to design and/or review specific building components or sub-components, and provide Shop Drawings and Delegated Design Submittals to meet the requirements of authorities having jurisdiction..

1.4 REFERENCE STANDARDS

.1 ASTM A36/A36M-19 Standard specification for carbon structural steel

.2 ASTM A108-18 Standard specification for steel bar, carbon and alloy, cold-finished

.3 ASTM A653/A653M-20 Standard specification for steel sheet, zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) by the hot-dip process

.4 Specification D1.1/D1.1M:2020 Structural welding code - steel

.5 STD S136-16 North American specification for the design of cold-formed steel structural members

.6 CSA W47.1:19 Certification of companies for fusion welding of steel

.7 STD W55.3-08 Certification of companies for resistance welding of steel and aluminum

.8 STD W59-18 Welded steel construction

.9 CSSBI - Design in Cold Formed Steel.

.10 MANUAL Decking design manual no. 31 - Design manual for composite decks, form decks and roof decks

.11 SSPC (The Society for Protective Coatings) - Steel Structures Painting Manual.

.12 SSPC 16-01 Steel structures painting manual. Volume 1: good painting practice

1.5 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide deck profile characteristics and dimensions, structural properties and finishes

.3 Shop Drawings:

.1 Indicate deck layout, spans, anchorage, support locations, projections, openings and accessories.

.2 Provide Shop Drawings stamped and signed by the delegated design professional.

1.6 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Certificates: Certify that Products meet or exceed specified requirements.

.3 Installation Data: Manufacturer's special installation requirements.

.4 Delegated Design Submittals:

.1 Submit documentation indicating compliance to design criteria, signed and sealed by the delegated design professional responsible for their preparation.

.1 Design Data: Include material data, calculations and details.

1.7 QUALITY ASSURANCE

.1 Conform to CSA-S136 and CSSBI 10M.

.2 Conform to CSSBI - Design in Cold Formed Steel..

.3 Welders' Certificates: Submit to Section 01 33 00, certifying welders employed on the Work, verifying qualification within the previous twelve (12) months to CSA-W47.1.

.4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

.5 Delegated Design Professional Qualifications: Professional Structural Engineer experienced in design of this Work and licensed in the province where the project is located.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Cut plastic wrap to encourage ventilation.

.3 Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

Part 2 Products

2.1 MATERIALS

.1 Sheet Steel: ASTM A653/A653M, Structural Quality

.1 Zinc-coated (galvanized) or zinc-iron alloy-coated (galvaneealed) by the hot-dip process, with LZC coating to ASTM A653/A653M

.2 Minimum Fy=230MPa

.2 Bearing Plates and Plates: ASTM A36/A36M steel, unfinished.

.3 Primer: As specified in Section 09 91 00.

2.2 PERFORMANCE / DESIGN CRITERIA

.1 Delegated Design: Design roof decking and connections by a licensed design professional using performance and design criteria as indicated.

.2 Design metal roof deck to CSA-S136 and CSSBI 10M.

.3 Calculate to structural limit stress design and maximum vertical deck deflection of 1/240.

.4 Lateral deflection of diaphragm shall not exceed 1/500 of the storey height.

2.3 ACCESSORIES

.1 Flute Closures: Closed cell foam rubber, 25 mm / 1 inch thick; profiled to fit tight to the deck.

.2 Valley Strips and Eave Strips: Fabricated of metal of same type and finish as deck.

2.4 FABRICATION

.1 Metal Deck: CSSBI 10M, sheet steel, configured as follows:

.1 Span Design: 3 span continous.

.2 Minimum Metal Thickness Excluding Finish: 0.8 mm / 22.

.3 Nominal Height: 38 mm / 1-1/2 inch, fluted profile.

.4 Formed Sheet Width: 32 inch / 800 mm.

.5 Side Joints: Lapped.

.2 Related Deck Accessories: Metal closure strips, cover plates, cant strips, 22 / 0.8 mm thick galvanized sheet steel; of profile and size as indicated.

.3 Fasteners: Galvanized hardened steel, self tapping, painted to match deck pre-coating colour.

.4 Weld Washers: Mild steel, uncoated, 19 mm / 3/4 inch outside diameter, 3 mm / 1/8 inch thick.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

3.2 INSTALLATION

.1 Erect metal deck to manufacturer's written instructions.

.2 Erect metal deck to CSSBI 10M.

.3 Bear deck on masonry or concrete support surfaces with 4 inch / 100 mm minimum bearing. Align and level.

.4 Bear deck on steel supports with 75 mm / 3 inch minimum bearing. Align and level.

.5 End laps shall be minimum 50mm / 2" and shall be formed over supports.

.6 Fasten ribbed deck to steel support members with 20mm / 3/4" puddle welds at 300 mm / 12 inches on centre maximum at interior and 20mm / 3/4" puddle welds at 150 mm / 6 inches on centre maximum at perimeter.

.7 Button punch all seams at 600mm (24" o.c.).

.8 Reinforce steel deck openings from 6 to 12 inches / 150 to 300 mm in size with 50 x 50 x 6 mm / 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

.9 For openings over 300mm (12"), provided C100 x 8 (C4x5.4) H-frame to frame opening

.10 Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.

.11 Install single row of foam flute closures above walls and partitions perpendicular to deck flutes.

.12 Position roof sump pans recessed 10 mm / 3/8 inch below roof deck surface, with flange bearing on top surface of deck, sealed watertight. Fusion weld at each deck flute.

.13 Place metal cant strips in position and fusion weld.

.14 Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

.15 Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint. Zinc rich paint to conform to CAN/CGSB-1.181 (or ASTM A780). No iron oxide paint accepted

.16 Provide 1.22mm x 200mm (18ga x 8 inch) continuous plate over the deck joint where metal deck changes orientation.

.17 Welding steel deck shall be done by companies certified by the Canadian Welding Bureau (CWB) under CSA W47.1. Welders shall be certified by the CWB for deck welding.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Steel roof deck and accessories.

.2 Formed steel eave strips, cant strips and valley strips.

.3 Framing for openings up to and including 450 mm / 18 inches.

.4 Bearing plates and angles.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-place Concrete: Concrete topping over metal roof deck.

.2 Section 05 12 00 - Structural Steel: Support framing for openings larger than 450 mm / 18 inches.

.3 Section 05 21 00 - Steel Joist Framing: Support framing for openings larger than 450 mm/ 18 inches.

.4 Section 05 31 13 - Steel Floor Decking.

.5 Section 03 30 00 – Cast-In-Place Concrete: Placement of anchors for bearing plates and angles cast in concrete.

.6 Section 04 29 00 - Reinforced Unit Masonry: Placement of anchors for bearing plates and angles embedded in masonry.

1.3 DEFINITIONS

.1 Delegated Design Professional: The specialist or supporting design professional contracted to the contractor, fabricator or manufacturer to design and/or review specific building components or sub-components, and provide Shop Drawings and Delegated Design Submittals to meet the requirements of authorities having jurisdiction.

1.4 REFERENCE STANDARDS

.1 ASTM A36/A36M-19 Standard specification for carbon structural steel

.2 ASTM A653/A653M-20 Standard specification for steel sheet, zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) by the hot-dip process

.3 STD S136-16 North American specification for the design of cold-formed steel structural members

.4 CSA W47.1:19 Certification of companies for fusion welding of steel

.5 STD W55.3-08 Certification of companies for resistance welding of steel and aluminum

.6 STD W59-18 Welded steel construction

.7 CSSBI - Design in Cold Formed Steel.

.8 MANUAL Decking design manual no. 31 - Design manual for composite decks, form decks and roof decks

.9 SSPC 16-01 Steel structures painting manual. Volume 1: good painting practice

1.5 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide deck profile characteristics and dimensions, structural properties and finishes.

.3 Shop Drawings:

.1 Indicate deck layout, spans, anchorage, support locations, accessories, openings and projections, .

.2 Provide Shop Drawings stamped and signed by the delegated design professional.

1.6 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Certificates: Certify that Products meet or exceed specified requirements.

.3 Installation Data: Manufacturer's special installation requirements.

.4 Delegated Design Submittals:

.1 Submit documentation indicating compliance to design criteria, signed and sealed by the delegated design professional responsible for their preparation.

.1 Design Data: Include material data, calculations and details.

1.7 QUALITY ASSURANCE

.1 Conform to CSA-S136 and CSSBI 10M.

.2 Conform to CSSBI - Design in Cold Formed Steel..

.3 Welders' Certificates: Submit to Section 01 33 00, certifying welders employed on the Work, verifying qualification within the previous twelve (12) months to CSA-W47.1.

.4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

.5 Delegated Design Professional Qualifications: Professional Structural Engineer experienced in design of this Work and licensed in the province where the project is located.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Cut plastic wrap to encourage ventilation.

.3 Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

Part 2 Products

2.1 PERFORMANCE / DESIGN CRITERIA

.1 Delegated Design: Design roof decking and connections by a licensed design professional using performance and design criteria as indicated.

.2 Design metal roof deck to CSA-S136 and CSSBI 10M.

.3 Calculate to structural limit stress design and maximum vertical deck deflection of 1/240.

.4 Lateral deflection of diaphragm shall not exceed 1/500 of the storey height.

2.2 MATERIALS

.1 Sheet Steel: ASTM A653/A653M, Structural Quality

.1 Zinc-coated (galvanized) or zinc-iron alloy-coated (galvaneealed) by the hot-dip process, with LZC coating to ASTM A653/A653M

.2 Minimum Fy=230MPa

.2 Bearing Plates and Plates: ASTM A36/A36M steel, unfinished.

.3 Primer: As specified in Section 09 91 00.

2.3 ACCESSORIES

.1 Flute Closures: Closed cell foam rubber, 25 mm / 1 inch thick; profiled to fit tight to the deck.

.2 Valley Strips and Eave Strips: Fabricated of metal of same type and finish as deck.

2.4 FABRICATION

.1 Metal Deck: CSSBI 10M, sheet steel, configured as follows:

.1 Span Design: 3 span continous.

.2 Minimum Metal Thickness Excluding Finish: 0.8 mm / 22.

.3 Nominal Height: 38 mm / 1-1/2 inch, fluted profile.

.4 Formed Sheet Width: 32 inch / 800 mm.

.5 Side Joints: Lapped.

.2 Related Deck Accessories: Metal closure strips, cover plates, cant strips, 22 / 0.8 mm thick galvanized sheet steel; of profile and size as indicated.

.3 Fasteners: Galvanized hardened steel, self tapping, painted to match deck pre-coating colour.

.4 Weld Washers: Mild steel, uncoated, 19 mm / 3/4 inch outside diameter, 3 mm / 1/8 inch thick.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

3.2 INSTALLATION

.1 Erect metal deck to manufacturer's written instructions.

.2 Erect metal deck to CSSBI 10M.

.3 Bear deck on masonry or concrete support surfaces with 4 inch / 100 mm minimum bearing. Align and level.

.4 Bear deck on steel supports with 75 mm / 3 inch minimum bearing. Align and level.

.5 End laps shall be minimum 50mm / 2" and shall be formed over supports.

.6 Fasten ribbed deck to steel support members with 20mm / 3/4" puddle welds at 300 mm / 12 inches on centre maximum at interior and 20mm / 3/4" puddle welds at 150 mm / 6 inches on centre maximum at perimeter.

.7 Button punch all seams at 600mm (24" o.c.).

.8 Reinforce steel deck openings from 6 to 12 inches / 150 to 300 mm in size with 50 x 50 x 6 mm / 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

.9 For openings over 300mm (12"), provided C100 x 8 (C4x5.4) H-frame to frame opening

.10 Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.

.11 Install single row of foam flute closures above walls and partitions perpendicular to deck flutes.

.12 Position roof sump pans recessed 10 mm / 3/8 inch below roof deck surface, with flange bearing on top surface of deck, sealed watertight. Fusion weld at each deck flute.

.13 Place metal cant strips in position and fusion weld.

.14 Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

.15 Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint. Zinc rich paint to conform to CAN/CGSB-1.181 (or ASTM A780). No iron oxide paint accepted

.16 Provide 1.22mm x 200mm (18ga x 8 inch) continuous plate over the deck joint where metal deck changes orientation.

.17 Welding steel deck shall be done by companies certified by the Canadian Welding Bureau (CWB) under CSA W47.1. Welders shall be certified by the CWB for deck welding.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Load bearing formed steel stud for exterior wall framing.

.2 Coordinate work of this section with work of other Sections that may have items supported by or built into wind load bearing steel stud systems, including; but not limited to connectors, doors, windows, architectural woodwork, plumbing fixtures, and electrical fixtures and panels.

1.2 RELATED SECTIONS

.1 Section 05 12 00 – Structural Steel Framing.

.2 Section 05 31 13 – Steel Floor Decking

.3 Section 05 31 23 – Steel Metal Decking

.4 Section 06 10 00 – Rough Carpentry

.5 Section 07 21 13 – Board Insulation

.6 Section 07 21 29 – Sprayed Insulation

.7 Section 07 26 00 – Air Barrier, Air/Vapour Retarders

.8 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing.

.9 Section 07 62 00 – Sheet Metal Flashing and Trim

.10 Section 09 21 16 – Gypsum Board

.11 Section 09 22 16 – Interior Non-Load Bearing Metal Stud Framing

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM):

- .1 ASTM A307-14, Carbon Steel Botls, Studs and Threaded Rod 60000PSI Tensile Strength.
- .2 ASTM A3125/3125M-14, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- .3 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized)0 by the Hot-Dip Process.

.2 American Society of Mechanical Engineers International (ASME):

- .1 ASME B18 Series Codes and Standards as referenced for specific screws, nuts, bolts and other fasteners.

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.181-99, ready-Mixed Organic Zinc-Rich Coating

.2 CAN/7.1-98, Lightweight Steel Wall Framing Components

.4 Canadian Sheet Steel Building Board (CSSBI):

.1 CSSBI51-06, Lightweight Steel Framing Design Manual 2nd Edition.

.5 Canadian Standards Association (CSA):

.1 CSA S16-04, Limit States Design of Steel Structures

.2 CSA S136-16, North American Specification for the Design of cold Formed Steel Structural Memebers

.3 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel

.4 CSA W48-06; Filler Metals and Allied Materials for Metal Arc Welding

.5 CSA W59-13; Welded Steel Construction (Metal Arc Welding)

1.4 DEFINITIONS

.1 Minimum Uncoated Steel Thickness: Minimum uncoated thickness of lightweight steel framing shall not be less than 95% of the thickness used in the design for the framing system.

.1 Lesser thickness may not be permitted at bends arising from the cold forming process.

.2 Metal thickness listed in this Section are minimum uncoated steel thickness; excusive of any subsequent coatings or treatments.

1.5 SYSTEM DESCRIPTION

.1 Wind Bearing Studs:

.1 Wall studs subjected to lateral loads (no axial loads other than self-weight and the weight of applied finishes)

.2 Steel bridging

.3 Top and bottom track

.4 Head, sill and jamb members for wall openings

.5 Stud, bridging and track connections

.6 Top and bottom connections to the main structure including detailing to accommodate floor and/or roof deflections.

.2 Axial Load Bearing Studs:

.1 Wall studs subject to lateral and axial loads

.2 Steel bridging

.3 Top and bottom track

.4 Lintel, sill and jamb members for wall openings

.5 Cross bracing for lateral loads

.6 Connections

1.6 DESIGN CRITERIA

.1 Perform design, fabrication and erection of the work of this Section based on Limit States Design principles using factored loads and resistances, determined in accordance with CSA S136.

.2 In accordance with the National Building Code of Canada, design wall framing system capable of withstanding design wind loads within limits and under design loads as follows:

- .1 Dead Loads: Weights of materials and construction.
- .2 Wind Loads: q_{50} for deflection and for strength, modified by the appropriate importance factor, exposure, gust effect factors, and pressure coefficients (internal and external) in accordance with commentary "I" of the NBC 2015 structural commentaries.
  - .1 Wind Load: 0.44 kpa 1/50 year occurrence in accordance with the Governing Building Code.
- .3 Earthquake Loads: Site Class C
- .4 Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 70 degrees Celsius.
- .5 Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure upward and downward movement of 13mm (1/2"); or larger gap as may be required to accommodate structural movement.
- .6 Design deflection detail so that free floating vertical members are restrained from horizontal movement by means of continuous bridging, nested or boxed tracks, or sliding or flexible web connections.
- .7 Maximum allowable deflection under q_{50} sustained wind loading (with the appropriate importance factors for ULS and SLS shall be as follows:
  - .1 Behind metal cladding – stud deflection limited to L/360.
- .8 Allow for movement of the structure; design lightweight steel framing end connections to accommodate floor and roof defections such that studs are not loaded axially; limit free play and movement in connections perpendicular to the plan of framing to +/-0.50mm relative to the building structure.
- .9 Design connections between light steel framing members using bolts, welding or sheet metal screws.
- .10 Design bridging to prevent member rotation and member translation perpendicular to the minor axis.
- .11 Design for secondary stress effects due to torsion between lines of bridging.
- .12 Collateral contribution of sheathing materials may be used to help restrain member rotation and translation perpendicular to the minor axis for wind bearing studs.

.13 Design bridging at 1524mm (5'-0") centres maximum, closer spacing may be required by design to satisfy structural requirements; spaced at even intervals over the span of the member.

.14 Resistances and resistance factors shall be determined in accordance with the National Building Code of Canada and CA/CSA-S136

.15 Conform to the requirements of fire rated assemblies as specified which have been tested in accordance with CAN/ULC-S101.

.16 Stud and joist depths are shown on the drawings. Adjust stud and joist material thicknesses and spacing, as required by the design criteria.

.3 Stud, sill and top track sizes and thicknesses, and fastening details indicated in this Section and on the drawings shall be considered as minimums only, spacing indicated as maximum permissible, except where changes are required to meeting design criteria, and as follows:

.1 Design head, sill and jamb members to frame opening larger than 100mm in any dimension.

.2 Design components or assemblies to accommodate specified tolerances of the structure.

.3 Sill and Top Tracks:

.1 Double track system, outer track flanges with depth to suit vertical deflection and width of studs

.2 Sill tracks, minimum 33mm deep flanges and width of studs

.4 Movement Connection Clips: Purpose made clip designed to allow structural member vertical movement and to transfer wind suction or pressure to structural frame.

.5 Maximum design spacing of stud members shall not exceed 406mm (16") centres.

.6 Maximum spacing for top and bottom track connections to the structure shall not exceed 813mm (32") centres.

.7 Minimum design thickness for wall framing members shall be as follows:

.1 64mm: 0.84mm

.2 92mm: 0.84mm

.3 101mm: 0.84mm

.4 140mm: 0.84mm

.5 152mm: 0.84mm

.6 184mm: 0.91mm

.7 203mm: 1.12mm

.8 Bridging Channel: 1.12mm minimum

.9 Clip Angles: 1.52mm minimum

1.7 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures

.2 Product Data Sheets: Submit for mechanical fasteners, indicating sizes, shear, and pull-over loading capacity where applicable. Provide data indicating thickness and type of corrosion protection coating.

.3 Shop Drawings:

.1 Each shop drawing submitted shall bear the stamp and signature of a qualified Professional Engineer registered in the Province of Ontario.

.2 Shop drawings indicating all construction details including connections and anchor requirements. Indicate type, size and spacing of fastening devices. Indicate design loads.

.3 Include all necessary shop details and erection diagrams with:

.1 Members sizes, locations, thickness (exclusive of coatings), metallic coatings, mechanical properties and material types.

.2 Connection details for attaching framing to itself and to the structure complete with the number and location of all screws or other fasteners. Show splice details where permitted.

.3 Dimensions, framing for openings, requirements of related work and critical installation procedures.

.4 Temporary bracing required for erection purposes.

.5 Detailed building wall elevations showing all wall opening. Indicate stud sizes, where built-up members are required, dimensions, and section marks on elevation drawings.

.6 Design wind loads shown.

.7 Welds indicated by welding symbols as defined in CSA W59.

1.8 QUALITY ASSURANCE

.1 Retain a Professional Engineer registered in the Province of Ontario to design the Metal Framing System; to prepare, seal and sign all shop drawings; and to preform field review. Shop drawings shall show both design and installation requirements.

.1 The installation of the exterior steel stud walls shall be inspected periodically by the Professional Engineer responsible for the component selection and connection designs for conformance to the shop drawings.

.2 Forward copies of inspection to the Consultant and Contractor

.3 Provide letter of General Conformance prior to Substantial Performance.

.2 Calculate structural properties of framing members in accordance with MFMA - Guidelines for the Use of Metal Framing and CSA W47.1, CSA W55.3, CSA W59 requirements.

.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

.4 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by manufacturer. If requested by Consultant, submit proof of experience to Consultant prior to commencement of the Work of this Section.

.5 Welder Qualification: Submit evidence of welder qualification meeting requirements for work being performed by this Section.

1.9 MOCK-UP

.1 Section 01 40 00 - Quality Control

.2 Provide mock-up of stud wall framing including insulation, sheathing, door frame, and interior and exterior finish specified in other sections.

.3 Mock-up Size: 2 x 2 x 2 m, including corner.

.4 Mock-up may remain as part of the Work.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Section 01 61 00 – Product Requirements.

.2 Delivery and Acceptance Requirements: Deliver steel stud framing clearly marker with core steel thickness by embossing, stamping with indelible ink or by colour coding.

.3 Storage and Handling Requirements: Store material flat, blocked off the ground in a manner to prevent kinking or permanent set; bent, kinked or twisted studs and track will be rejected.

PART 2 Products

2.1 MANUFACTURERS

.1 Bailey Metal Products Ltd.
One Caldari Road
Concord, Ontario L4K 3Z9
1-800-668-2154

.2 Substitutions: Refer to Section 01 62 00 –Product Exchange Procedures.

2.2 MATERIALS

.1 Wind Bearing Steel Framing Members and Accessories:

.1 Steel conforming to CSA S136 and shall be identified as to specification, type, grade and mechanical properties; metal core thickness and spacing determined by Professional Engineer, hot-dipped galvanized steel, roll formed with knurled flanges, and cut-outs for services and bracing.

.2 Colour coding: In accordance with Lightweight Steel Framing Manual, published by Canadian Sheet Steel Building Institute.

.2 Fasteners and Welds:

.1 Welding materials conforming to CSA W59; electrodes minimum 480 MPa tensile strength

.2 Bolts and nuts conforming to ASTM A307 or ASTM A325, with washers and hot-dip galvanized finish.

.3 Metal to Metal: Sheet metal screws conforming to ASME 18, with minimum 0.008mm thick galvanized coating and #8 diameter; self-drilling, self-threading, case hardened type, hex, pan, and low-profile head profile

type to suit application; length sufficient to penetrate not less than 3 fully exposed threads beyond joined materials.

.4 Metal to Concrete: Drilled insert, minimum 6.4mm (1/4") diameter, do not use Powder Actuated fasteners

.5 Metal to Structural Steel: Secure track to structural steel over 8mm thickness with proprietary fastening system:

.6 Touch up Paint: Zinc-rich, in accordance with CAN/CGSB 1.181M

.7 Moisture Barrier: closed-cell neoprene foam sealer gasket

PART 3 Execution

3.1 GENERAL

.1 Fabrication and erection shall conform to the approved shop drawings. Modifications required to accommodate as-built conditions (other than minor dimensional changes) shall be submitted to Consultant and Professional Engineer for approval.

3.2 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation.

.2 Verify that substrate surfaces and building framing components are ready to receive work.

.3 Verify that rough-in utilities are in proper location.

3.3 ERECTION

.1 Lightweight Steel Framing shall be erected true and plumb within the specified tolerances. Temporary bracing shall be employed wherever necessary to withstand all loads to which the structure may be subject during erection and subsequent construction. Temporary bracing shall be left in place as long as required for the safety and integrity of the structure. The Erector shall ensure that during erection a margin of safety consistent with the requirements of the National Building Code and CAN/CSA-S136 exists in the uncompleted structure.

.2 Fabrication and erection shall conform to the reviewed Shop Drawings, modification required to accommodate on-site conditions, other than minor dimensional changes, submitted to the Consultant for acceptance prior to proceeding with work.

.1 Provide continuous top and bottom tracks.

.2 Align exterior wall partition tracks at floor and underside of deck, isolate track from direct contact with concrete using moisture barrier.

.3 Cut bottom of studs square and set with full contact in bottom track; screw fasten both flanges to sill track.

.4 Place studs vertically at not more than 50mm (2) from abutting walls, and at each side of opening and corners; position studs in tracks at floor and ceiling, unless noted otherwise.

.5 Cut members using saw or shear; flame cutting is not permitted.

.6 Provide cross studs secured to studs, and additional framing as required for support of fixtures mounted to walls.

.3 Erection tolerances shall be as follows:

.1 Erect steel studding to tolerance of +/- 3mm (1/8”), non cumulative from design spacing. Spacing in any case shall not exceed the requirements of the finishing materials.

.2 Out-of-plumb- shall not exceed 1/500 of the member length.

.3 Out-of-straight (camber or sweep) shall not exceed 1/1000 of the member length.

.4 Track camber shall not exceed 1/1000 of member length.

.5 Studs shall not exceed 4mm (5/15”) for lightweight steel framing.

.6 Distance from centerline of last un-reinforced cut-out to end of framing member shall not be less than 305mm (12”)

.4 Coordinate simultaneous erection of studs with installation of service lines; align web opening when erection studs.

.5 Coordinate erection of studs with installation of door/window frames and special support or anchors for work specified in other Sections.

.6 Provide two studs extending from floor to ceiling at each side of opening wider than stud centres specified; secure studs together using sheet metal and screw fasteners.

.7 Erect track at head of door openings and sills of sidelight/window opening to accommodate intermediate studs; secure track to studs at each end; install intermediate studs above and below opening in same manner and spacing as wall studs.

.8 Perform welding in accordance with CSA W59; for material less than 3mm (1/8”) thick, the effective throats of welds shall not be less than the thickness of the thinnest connection part:

.1 Mechanically fasten all members having a thickness of 0.91mm and less; weld or mechanically fasten all members having a thickness of 1.12mm and greater.

.9 After erection, refinish damaged finishes, welds, fastener heads and nuts with zinc-rich paint, in accordance with paint manufacturer’s instruction.

3.4 FIXTURE ATTACHMENT AND ACCESS PANELS

.1 Install all attachments within steel-stud partitions for fixtures being hung from or anchored to such partitions.

.2 Install access doors to electrical or mechanical fixtures supplied under respective Section.

.3 Rigidly secure frames to furring or framing systems.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Shop fabricated miscellaneous metal items.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-place Concrete: Placement of metal fabrications in concrete.

.2 Section 05 12 00 - Structural Steel: Structural steel column anchor bolts.

.3 Section 05 21 00 - Steel Joist Framing: Structural joist bearing plates, including anchorage.

.4 Section 05 31 23 - Steel Roof Deck: Bearing plates and angles for metal deck bearing, including anchorage.

.5 Section 05 31 13 - Steel Floor Decking: Bearing plates and angles for metal deck bearing, including anchorage.

.6 Section 04 05 19 Masonry Anchorage and Reinforcing

.7 Section 09 91 00 - Painting: Paint finish.

1.3 REFERENCE STANDARDS

.1 ASTM A53/A53M-20 Standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless

.2 ASTM A153/A153M-16a Standard specification for zinc coating (hot-dip) on iron and steel hardware

.3 ASTM A307-21 Standard specification for carbon steel bolts, studs, and threaded rod 60 000 PSI tensile strength

.4 ASTM A500/A500M-21a Standard specification for cold-formed welded and seamless carbon steel structural tubing in rounds and shapes

.5 ASTM A501/A501M-21 Standard specification for hot-formed welded and seamless carbon steel structural tubing

.6 STD G40.20/G40.21-13 General requirements for rolled or welded structural quality steel/structural quality steel

.7 CSA W47.1:19 Certification of companies for fusion welding of steel

.8 STD W55.3-08 Certification of companies for resistance welding of steel and aluminum

.9 STD W59-18 Welded steel construction

.10 Maintenance repainting specification manual

.11 SSPC 16-01 Steel structures painting manual. Volume 1: good painting practice

.12 CSA S16:19 Design of steel structures

1.4 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Shop Drawings:

.1 Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

.2 Indicate welded connections using standard welding symbols. Indicate net weld lengths.

.3 Miscellaneous metals shop drawings are to be stamped by a structural engineer practicing in the province of Ontario.

.4 Design of steel connections to the maximum UDL loads in steel handbook beam tables, provided no point loads act on the beam and when shears are not indicated

.5 Connections shall be concentric and shall not introduce eccentricity into any elements.

1.5 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

1.6 QUALITY ASSURANCE

.1 Welders' Certificates: Submit to Section 01 33 00 requirements, certifying welders employed on the Work, verifying qualification within the previous twelve (12) months to CSA-W47.1 (steel).

.2 Welded Steel Construction: CSA-W59.

.3 Welded Aluminum Construction: CSA-W59.2.

.4 Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the place where the Project is located.

Part 2 Products

2.1 MATERIALS - STEEL

.1 Structural Steel Beam and Columns: ASTM A992/992M, Grade 50 (Fy = 345 MPa) unless otherwise noted.

.2 Structural Channels and Angles: CSA-G40.20/G40.21, Grade 300W unless otherwise noted.

.3 H.S.S.: CSA-G40.20/G40.21, Grade 350W (Class C) unless otherwise noted.

.4 Steel plate.: A36, Grade 250W minimum unless otherwise noted.

.5 Bolts, Nuts, and Washers: ASTM A325 bolts, galvanized to A153/A153M for galvanized structural members.

.6 Anchor Bolts: ASTM F1554 (formerly ASTM A307). Material shall be a minimum of Grade 36 (Fu = 414MPa) or CSA G40.21 300W (Fu=450MPa)..

.7 Welding shall conform to CSA W47.1 and CSA W59, by the Canadian Welding Bureau. All welding shall be completed by CWB Certified Welders. Third party welding inspection shall be performed by firms certified to CSA W178.1 and W178.2.

.8 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, with a compressive strength of 35 MPa (minimum). Grout shall be installed at a maximum of 38mm (1 1/2").

.9 Primer: As specified in Section 09 91 00.

2.2 FABRICATION

.1 Fit and shop assemble items in largest practical sections, for delivery to site.

.2 Fabricate items with joints tightly fitted and secured.

.3 Continuously seal joined members by continuous welds.

.4 Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

.5 Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

.6 Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATION TOLERANCES

.1 Squareness: 3 mm / 1/8 inch maximum difference in diagonal measurements.

.2 Maximum Offset Between Faces: 1.6 mm/ 1/16 inch.

.3 Maximum Misalignment of Adjacent Members: 1.6 mm/ 1/16 inch.

.4 Maximum Bow: 3 mm in 1.2 m/ 1/8 inch in 4 ft.

.5 Maximum Deviation From Plane: 1.6 mm in 1.2 m/ 1/16 inch in 4 ft.

2.4 FINISHES - STEEL

.1 Prepare surfaces to be primed in accordance with SPCC SP 2.

.2 Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

.3 Do not prime surfaces in direct contact with concrete or where field welding is required.

.4 Prime paint items with one (1) coat.

.5 Structural Steel Members: Galvanize after fabrication appropriate grade for type and size of steel material indicated, with zinc coating thickness ASTM A123/A123M.

.6 Non-structural Items: Galvanized after fabrication to appropriate grade for type and size of steel material indicated, with zinc coating thickness ASTM A123/A123M.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

.2 Verify that field conditions are acceptable and are ready to receive work.

.3 Verify dimensions, tolerances, and method of attachment with other work.

3.2 PREPARATION

.1 Clean and strip primed steel items to bare metal where site welding is required.

.2 Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

.1 Install items plumb and level, accurately fitted, free from distortion or defects.

.2 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

.3 Field weld components indicated on Drawings or Shop Drawings.

.4 Perform field welding to CSA requirements.

.5 Obtain approval prior to site cutting or making adjustments not scheduled.

.6 After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

.1 Section 01 73 00: Tolerances.

.2 Maximum Variation From Plumb: 6 mm / 1/4 inch per story, non-cumulative.

.3 Maximum Offset From True Alignment: 6 mm / 1/4 inch.

.4 Maximum Out-of-Position: 6 mm / 1/4 inch.

END OF SECTION

PART 1. General

1.1 Related Sections

.1 Conform to the requirements of Division 1.

.2 Section 03 30 00 Cast-in-Place Concrete

1.2 References

.1 ASTM International (ASTM)
- .1 ASTM A167 - 99(2009) Standard Specification for Stainless and Heat-Resisting Chromium- Nickel Steel Plate, Sheet, and Strip
- .2 ASTM A269/A269M-15a Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- .3 ASTM A312/A312M-17 Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- .4 ASTM C595/C595M-19 Standard Specification for Blended Hydraulic Cements
- .5 ASTM E488/E488M-15 Standard Test Methods for Strength of Anchors in Concrete Elements
- .6 ASTM E894-18 Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings
- .7 ASTM E935-13e1 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings
- .8 ASTM E985 - 00e1 Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

.2 American Iron and Steel Institute (AISI)
- .1 Steel Products Manual; Stainless and Heat Resisting Steel.

.3 American Welding Society (AWS):
- .1 AWS D1.2, Structural Welding Code – Aluminum.

.4 National Association of Architectural Metal Manufacturers (NAAMM):
- .1 NAAMM MFM, Metal Finishes Manual.

.5 The Ontario Building Code.

.6 The National Building Code of Canada

1.3 Submittals

.1 Make submittals in accordance with Section 01 33 00 – Shop Drawings.

.2 Shop Drawings
.1 Show and describe in detail all the work of this Section including large scale detail of members and materials, of connection and jointing details, and of anchorage devices, dimensions, gauges, thicknesses, description of materials, metal finishing, as well as all other pertinent data and information, including type, size and description of all fasteners and anchors.
.2 Indicate connections to paving surface.
.3 Shop drawings for all guardrail construction shall be stamped and signed by a Professional Engineer licensed in the Province of Ontario. Include structural analysis data signed and sealed by the professional engineer who was responsible for their preparation, demonstrating compliance with the referenced codes and standards.

.3 Samples:
.1 Finish Selection: Provide sections of railing or flat sheet metal which depict available surface finishes.
.2 Verification Samples: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the work. If finishes involve normal colour and texture variations, include sample sets showing the full range of variations expected.
.1 152 mm long sections of each different linear railing member, including handrails, base shoe and top rails.

1.4 Definitions

.1 Refer to definitions in ASTM E985 for railing-related terms that apply to this Section.

1.5 Design Requirements

.1 Design handrails, guardrails, and connections to OBC and NBC vertical and horizontal live load requirements.

.2 Structural Performance: Provide railing systems capable of withstanding the following structural loads without exceeding allowable design working stress of materials for railings, anchors, and connections:
.1 Top Rail: Shall withstand the following loads:
.1 Concentrated load of 890 N applied at any point and in any direction.
.2 Uniform load of 730 N/m applied horizontally or vertically downward.
.3 Concentrated and uniform loads above need not be assumed to act concurrently.
.2 Handrails not Serving as Top Rails: Shall withstanding the following loads:
.1 Concentrated load of 890 N applied at any point and in any direction.
.2 Uniform load of 730 N/m applied in any direction.
.3 Concentrated and uniform loads above need not be assumed to act

concurrently.

.3 Corrosion Resistance: Separate incompatible materials to prevent galvanic corrosion.

1.6 Quality Assurance

.1 Design criteria: railing assemblies (including top rail, bottom rail, additional handrail, post, and connections) shall be designed to conform to all applicable building codes and loading requirements.

.2 Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

.3 Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture stainless steel balustrade railing systems of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 15 years.

.4 Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing stainless steel balustrade railing systems similar in type and scope to that required for this Project.

.5 Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, Provincial, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

.6 Single Source Responsibility: Obtain stainless steel balustrade railing systems from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work.

1.7 Shipping, Handling and Storage

.1 Refer to Section 01 62 00 – Products & Substitutions.

.2 Deliver, handle and store materials in accordance with manufacturer’s printed instructions.

.3 Deliver materials to the job site in good condition and adequately protected against damage.

.4 Store on site in a location and manner to avoid damage. Stacking should be done in a manner that will prevent bending. Store material in a clean, dry location away from uncured concrete. Any protection on the railings during transportation should remain until installed.

.5 Materials to be stored at not lower than -40°C or higher than 100° C.

.6 Keep handling on site to a minimum. Exercise caution to avoid damage to finishes of material.

.7 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 Project Conditions

.1 All measurements for handrails and railings should be taken from construction site elements to which railings are to fasten. This information to be recorded on final shop drawings.

.2 Coordinate fabrication and delivery schedule of handrails with construction progression and sequence to avoid delay of railing installation.

.3 Environmental Requirements: Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 Waste Management and Disposal

.1 Refer to Section 01 74 00 – Cleaning & Waste Management.

1.10 Warranty

.1 Warrant the work of this Section against defects of workmanship and material, for a period of five years from the date of Substantial Performance and agree to make good promptly any defects which occur or become apparent within the warranty period.

PART 2. Products

2.1 Materials

.1 Metals: Provide metal free from pitting, seam marks, roller marks, stains, discolourations, and other imperfections where exposed to view on finished units.

.2 Provide alloy and temper recommended by producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each form required.

.3 Expansion Cement: Hydraulic, conforming to ASTM C595.

.4 Stainless steel railings, and guardrails as detailed. Provide complete railing systems as indicated complete with posts, rails, brackets, saddles, end caps and connectors.

.5 Provide manufacturer standard fittings, connectors, adapter strips, splice pins, hardware and accessories as required for a complete installation.

2.2 Finishes

.1 Stainless Steel: Type 316 unless noted otherwise.
  .1 Pipe and Tubing: ASTM A269 or ASTM A312.
  .2 Finish: Brushed finish.

2.3 Fabrication

.1 Fabricate railing system for compliance with structural requirements of applicable codes.

.2 Pre-assemble railings prior to shipping to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and for coordination with shop drawings.

PART 3. Execution

3.1 Preparation

.1 Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts and miscellaneous items having integral anchors that are to be embedded in concrete construction.

3.2 Installation

.1 Install work in accordance with reviewed shop drawings and manufacturer's instructions.

.2 Erect work plumb, square and level, free from distortion or defects detrimental to appearance or performance.

.3 Maximum offset from true alignment for every 15 m of railing shall be 6.0 mm, non-accumulative.

.4 Provide protective covering on all hand and guardrails if construction is not yet finished in the area.

3.3 Field Quality Control

.1 Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports in accordance with Section 01 45 00 Quality Control.

.2 Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ANSI Z97.1, ASTM E894 and ASTM E935 for compliance with performance requirements.

.3 Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to

Consultant and comply with specified requirements.

.4 Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Wash railing using clean water and soap, rinse with water.

.3 Do not use acid solution, steel wool, or other harsh abrasives.

.4 After installation, be responsible for protecting the railings during the balance of construction.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Work to be completed by **Heritage Woodworker. Heritage Woodworker** is responsible to undertake the following:

.1 Section 06 03 10 - Finish Carpentry Restoration and Replication.

.2 Section 08 20 00 – Wood Doors and Frames.

.3 Preparation of new wood doors to receive glazing and door hardware.

.4 Section 09 03 98 - Restoration Painting and Coating.

.5 New wood stairs to Pit.

.6 Restoration of existing door hardware for Door 101E1, 101E2, and 101 E3 as indicated on drawings.

.7 Modification of existing window hardware as indicated on drawings.

.8 Modification of existing door hardware as indicated on drawings.

.2 The intent of this work is to repair the existing historic fabric using minimal intervention and reversible techniques wherever possible. It is not the intention to make the building fabric look in pristine new condition.

.3 Replicate wood elements (trims, casing, wood baseboard, etc. to suit new work)

.4 Repair interior and exterior wood elements as indicated on drawings.

.5 Modified existing wood elements to suit new construction.

1.2 SECTION INCLUDES

.1 Remove and discard existing wood trim/mouldings as noted. Replicate and install wood corner trims and wood mouldings with new to match original profile and wood species.

.2 Epoxy patching of existing finish carpentry components as noted.

1.3 RELATED SECTIONS

.1 Section 08 20 00 – Wood Doors and Frames

.2 Section 08 71 00 – Door Hardware

.3 Section 08 80 50 – Glazing

.4 Section 09 03 98 – Restoration Paint and Coatings.

1.4 SUBMITTALS

.1 Section 01 35 91 – Restoration Project Procedures.

.2 Site Inventory and photo documentation of existing conditions.

.3 **Method Statement:** Include one comprehensive Method Statement for the **Heritage Woodwork**; inclusive of the Work of this Section, Section 06 03 10 Finish Carpentry Restoration & Replication, wood stairs, Section 08 20 00 Wood

Doors and Frames and Section 09 03 98 Restoration Painting and Coating; outlining as a minimum all methods, procedures, materials and understanding of the work utilizing good conservation practices.

.4 **Shop Drawings:** Indicate materials, component profiles, fastening methods, jointing details, accessories, and finishes, to scale appropriate to the illustrated scope of work.

.5 **Samples:** Submit two (2) samples 300mm in size illustrating each trim profile to be replicated.

.6 **Product Data Sheets and MSDS sheets**: Submit for all products to be used.

1.5 CLOSEOUT SUBMITTALS

.1 Section 01 78 10 – Closeout Submittals: Submission procedures.

1.6 MOCK-UP

.1 Section 01 35 91 – Restoration Project Procedures.

.2 Provide Mock-ups of following components:

.1 Replication of door casing and baseboard.

.2 Epoxy repair.

.3 Include wood restoration process and finishing, associated attachments, joints and junctions, terminating items.

.4 Locate where directed by Consultant.

.5 Approved mock-up may remain as part of the Work if agreed to by the Consultant and Owner.

1.7 DELIVERY, STORAGE, AND PROTECTION

.1 Section 01 61 00 – Product Requirements: Transport, handle, store, and protect Products.

.2 Store materials minimum 150 mm above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation.

.3 Do not store seasoned materials in damp location.

.4 Protect Work from moisture damage.

1.8 FIELD MEASUREMENTS

.1 Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

.1 Coordinate the Work with installation of associated and adjacent components, and windows.

1.10 EXTENDED WARRANTY

.1 Submit warranty for Work of this section in accordance with the General Condition, except that the warranty period is extended to two (2) years.

.1 Warranty against defects in materials and workmanship including but not limited to opening of joints, cracking, shrinkage, and warpage.

Part 2 Products

2.1 MATERIALS

.1 Lumber:

.1 Salvaged and/or original wood.

.2 If salvaged and/or original materials are unsuitable for use or are not available in sufficient quantities, provide new materials or materials salvaged from an off-site source to match original wood (dense old growth) in species, cut, appearance, and other characteristics.

.3 Do not reuse rotten, split, termite damaged, or otherwise defective pieces.

2.2 ACCESSORIES

.1 Consolidant: Low viscosity penetrating consolidant, 8-hour minimum cure time.

.1 Product: 2 part low viscosity (LV) epoxy and ceramic (grey tone) or phenolic microballoon (brown tone) epoxy/microballoon fills. Manufacturer West Systems epoxy resins, fillers and microballoons (available through Lee Valley) or approved equal.

.2 Fish Glue, available through Lee Valley.

.3 Waterproof Adhesives: Phenol and resorcinol resin adhesives for wood, conform to CSA 0112 Series M1977 – Standards for Wood Adhesives. Submit proposed product for Consultant's review.

.4 Fasteners, Expansion Shields, and Anchors: Type and size as required by conditions of use; plain steel for interior use; stainless steel for exterior use.

.1 Medium duty fasteners: 100% purer lead shields with brass screws and brass washers. Plastic or galvanized fittings are not acceptable.

.2 Heavy duty fasteners: Heavy-duty anchors, type 316 stainless steel, conforming to GSA Specification FF-S-325, Group VIII, Type 1. Acceptable product: SS Rawl-stud, 10x 89mm.

2.3 FABRICATION

.1 Fabricate new wood components with profiles and dimensions to match original using salvaged materials as a template.

Part 3 Execution

3.1 EXAMINATON

.1 Examine the areas in which the Work of this Section is to be located and fully determine the scope of repairs intended.

.2 Report defects which affect the scope of work as shown on the drawings and described herein.

.3 Do not begin work until unacceptable site conditions have been corrected.

.4 Verify proposed schedule of repairs and obtain acceptance for any additional work before proceeding.

3.2 PREPARATION

.1 Prior to installation, condition wood to average humidity that will prevail after installation.

.2 Back prime exterior wood and wood in contact with masonry or cementitious materials prior to installation.

.3 Protect all adjacent areas and adjoining materials against damage.

3.3 REPLICATION OF EXISTING ELEMENTS/COMPONENTS

.1 Remove existing damaged and deteriorated wood in manner to minimize damage to adjacent surfaces.

.2 Fit new components to original profiles and lines.

.3 Feather new materials into existing.

.4 Secure at maximum 300 mm on centre. Use concealed or exposed nailing to match original.

.5 Mitre corners and/or end joints to match existing.

.6 Scribe to adjacent construction with maximum 3 mm gaps.

.7 Sand cut ends and edges smooth.

3.4 CONSOLIDATION OF EXISTING WOOD

.1 Apply consolidant to manufacturer's written instructions.

.2 Completely saturate damaged wood with consolidant; allow to cure eight (8) hours minimum.

.3 Apply to end grain where exposed. Where end grain is not exposed, drill 3 mm holes staggered and at angles to side grain to expose as much end grain as possible.

.4 Prevent leakage with wax or clay plugs. Clean leakage before it cures.

.5 Apply second coat if first coat does not completely saturate and harden wood.

3.5 PATCHING AND REPAIR OF EXISTING WOOD

.1 Mix and apply epoxy putty/patching compound to manufacturer's written instructions.

.2 Apply epoxy putty/patching compound to fill voids after consolidant has cured.

.3 Embed wood in centre of large patches to reduce amount of filler.

.4 After filler has cured, sand, chisel or plane off to smooth surface, flush with adjacent surfaces.

3.6 DUTCHMEN

.1 Disinfect before installing.

.2 Wood and grain direction to match.

.3 Use phenol or resorcinol resin adhesives for wood. Submit proposed product for Consultant review prior to starting work.

3.7 WOOD FILL

.1 For smaller holes caused by previously installed nails, screws, clips, etc.

.2 Fill small holes with epoxy wood filler. Fill to be flush with surrounding wood.

3.8 GENERAL REPAIRS

.1 Remove rotted wood as directed.

.2 Scrub all affected surfaces of wood with a bleach and detergent mixture in water to remove and kill fungus. Rinse with water. Rinse with bleach mixture. Allow to dry.

.1 Bleach and detergent mixture: Mix 1 litre bleach with 50ml detergent with 200ml Tri-sodium phosphate and 3 litres of water to create cleaning solution.

.2 Bleach mixture: Mix bleach and water 1:1. Ensure no bleach splashes on any of the millwork as it will permanently mark the unfinished millwork.

.3 Take apart removable sections of woodwork and reset after repair of individual pieces.

.4 Insert one-piece wood Dutchmen into large voids. Set Dutchmen with grain in same direction as wood piece being replaced.

.5 Bed Dutchmen in semi-rigid patching compound. Fill all voids.

.6 Fill all open edge grain, checks, wanes and knot holes with epoxy/microballoon semi-rigid patching compound specified under this section

.7 After curing, sand down repairs for refinishing.

.8 Refer to West System User Manual for primary guide to the handling and basic techniques of epoxy/microballoon use, or manual of other approved system.

.9 Shave cured, exposed compound down to the original surface with woodworking tools.

.10 Construct new components in shop for site installation.

.11 Protect and be responsible for making good of any damage to finishes or materials caused by spillage of resins or paints at no additional cost to Owner.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Floor, wall, and roof framing.

.2 Sheathing.

.3 Miscellaneous rough carpentry, including:

.1 Wood blocking, cants and nailers.

.2 Wood furring.

.3 Wood sleepers.

.4 Fasteners.

1.2 RELATED REQUIREMENTS

.1 Section 04 29 00 - Reinforced Unit Masonry: Setting anchors in masonry.

.2 Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.

.3 Section 05 12 00 - Structural Steel: Prefabricated steel structural supports.

.4 Section 06 15 00 - Wood Decking: Wood roof decking to receive wood curbs and cants.

1.3 REFERENCE STANDARDS

.1 ASTM A123/A123M-17 Standard specification for zinc (hot-dip galvanized) coatings on iron and steel products

.2 ASTM A153/A153M-16a Standard specification for zinc coating (hot-dip) on iron and steel hardware

.3 ASTM A653/A653M-20 Standard specification for steel sheet, zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) by the hot-dip process

.4 CAN/CGSB 11.3-M87 Hardboard

.5 Canadian plywood handbook

.6 CSA O80 SERIES:21 Wood preservation

.7 STD O151-17 Canadian softwood plywood

.8 CSA O325:21 Construction sheathing (adopted NIST PS 2-18, with Canadian deviations)

.9 STD O437 SERIES-93 Standards on OSB and waferboard

.10 Standard grading rules for Canadian lumber

.11 CAN/CSA-O86 "Engineering Design in Wood".

1.4 ACTION SUBMITTALS

.1 Section 01 33 00: Submission procedures.

1.5 INFORMATIONAL SUBMITTALS

.1 Section 01 33 00: Submission procedures.

1.6 QUALITY ASSURANCE

.1 Perform Work in accordance with the following agencies:

.1 Lumber Grading Agency: Certified by NLGA Grading Rules.

.2 Plywood Grading Agency: Certified by CANPLY.

.3 Wood Based Panel Products: Marked with a recognized, visible grade stamp showing Grade or span rating as required.

.2 Pressure Preservative Treated Wood: Marked with certification mark authorized by the Canadian Wood Preservers Bureau (CWPB) indicating producer, preservative type, retention and Use Category (UC).

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Store plywood panels flat and level.

.3 Keep finish faces inward and cover stacks to protect from bumping and abrasion.

.4 Protect tongue and groove plywood panel edges and corners.

.5 Protect panels from sunlight, water or excessive humidity.

.6 Store materials off the ground, covered with weatherproof tarps.

Part 2 Products

2.1 LUMBER MATERIALS

.1 Dimension Lumber: CSA-O86, softwood lumber unless indicated otherwise, SPF No.1/2, maximum moisture content 19%; graded to NLGA Grading Rules Standard Grading Rules for Lumber. Finger jointed lumber not acceptable.

.2 Laminated Veneer Lumber (LVL): CSA-O86, Weyerhauser 2.0E Microllam LVL, with minimum values:E = 2.0 x 10^6, fb = 4,805 psi, fv = 530 psi, G = 125,000 psi, fc_perp = 1365 psi

.1 Approved equivalents: West Fraser LVL 3100 Fb 2.0E; LP Solid Start LVL 2900 Fb 2.0E; International Beams LVL 2.0E; Boise Cascade Versa-LAM 3100 2.OE; Boise Cascade GP-LVL 2.0E (formerly GP LAM LVL 2.0E)

2.2 PANEL MATERIALS

.1 Plywood: CSA-O151 as indicated in schedule below, certified and graded by CANPLY, meeting the requirements of CSA-O325. Minimum 1/2" (12.5mm) U.N.O.

.2 OSB: Oriented strands set with waterproof resin binder, meeting the requirements of CSA-O325. Minimum 3/8" (9.5mm) U.N.O.

2.3 FASTENERS AND ANCHORS

.1 Screws and Nails: Galvanized steel; type and size suitable for application.

.2 Anchors: Galvanized steel

2.4 CONNECTORS AND PLATES

.1 Bearing Plates: Galvanized steel, size and thickness as indicated.

.2 Joist Hangers: Galvanized steel, sized to suit framing conditions.

2.5 MISCELLANEOUS ACCESSORIES

.1 Sill Gasket (top of foundation wall): 6 mm/ 1/4, as indicated thick, plate width Closed cell polyethylene foam.

.2 Polyethylene: Sheet polyethylene, 0.25 mm / 10 mil thick.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

.2 Verify that site conditions are ready to receive work and opening dimensions are as indicate on the tender drawings.

3.2 FRAMING

.1 Set structural members level and plumb, in correct position.

.2 Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

.3 Place horizontal members, crown side up.

.4 Construct load bearing framing and curb members full length without splices.

.5 Double members at openings over 16" wide. Space short studs over and under opening to stud spacing.

.6 Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists. Frame rigidly into joists.

.7 Place full width continuous sill flashings under framed walls on cementitious foundations. Lap flashing joint 100 mm/ 4 inches.

.8 Place sill gasket directly on cementitious foundation. Puncture gasket clean and fit tight to protruding foundation anchor bolts.

.9 Coordinate installation of wood decking.

3.3 SHEATHING

.1 Secure roof sheathing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearing.

.2 Provide solid edge blocking between sheets.

.3 Secure subfloor sheathing with longer edge perpendicular to floor framing and with end joints staggered and sheet ends over bearing. Attach with subfloor glue.

.4 Install plywood to two-span continuous.

.5 Install flooring underlayment after dust and dirt generating activities have ceased and prior to application of finished flooring. Apply perpendicular to subflooring, stagger joints of underlayment.

.6 Glue and screw underlayment to subfloor.

3.4 ERECTION TOLERANCES

.1 Section 01 73 00: Tolerances.

.2 Framing Members: 6 mm/ 1/4 inch from true position, maximum.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Miscellaneous rough carpentry, including:

.1 Minor rough framing.

.2 Wood blocking and nailers.

.3 Wood sleepers.

.4 Wood shelving.

.2 Fasteners.

.3 Preservative treatment.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.

.2 Section 05 12 00 - Structural Steel: Prefabricated steel structural supports.

.3 Section 06 15 00 - Wood Decking: Wood decking to receive wood framing

1.3 REFERENCE STANDARDS

.1 Canadian plywood handbook

.2 CSA O80 SERIES:21 Wood preservation

.3 STD O151-17 Canadian softwood plywood

.4 Standard grading rules for Canadian lumber

.5 CAN/CSA-O86 "Engineering Design in Wood".

1.4 QUALITY ASSURANCE

.1 Perform Work in accordance with the following agencies:

.1 Lumber Grading Agency: Certified by NLGA Grading Rules.

.2 Plywood Grading Agency: Certified by CANPLY.

.3 Wood Based Panel Products: Marked with a recognized, visible grade stamp showing Grade or span rating as required.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Store plywood panels flat and level.

.3 Keep finish faces inward and cover stacks to protect from bumping and abrasion.

.4 Protect panels from sunlight, water or excessive humidity.

.5 Store materials off the ground and covered with weatherproof tarps or indoors in dry, well-ventilated area.

Part 2 Products

2.1 LUMBER MATERIALS

.1 Dimension Lumber: CSA-O86, softwood lumber unless indicated otherwise, SPF No.1/2, maximum moisture content 19%; graded to NLGA Grading Rules Standard Grading Rules for Lumber. Finger jointed lumber not acceptable.

.2 Laminated Veneer Lumber (LVL): CSA-O86, Weyerhauser 2.0E Microllam LVL, with minimum values:E = 2.0 x 10^6, fb = 4,805 psi, fv = 530 psi, G = 125,000 psi, fc_perp = 1365 psi

.1 Approved equivalents: West Fraser LVL 3100 Fb 2.0E; LP Solid Start LVL 2900 Fb 2.0E; International Beams LVL 2.0E; Boise Cascade Versa-LAM 3100 2.OE; Boise Cascade GP-LVL 2.0E (formerly GP LAM LVL 2.0E)

2.2 PANEL MATERIALS

.1 Plywood: CSA-O151 as indicated in schedule below, certified and graded by CANPLY, meeting the requirements of CSA-O325. Minimum 1/2" (12.5mm) U.N.O.

.2 OSB: Oriented strands set with waterproof resin binder, meeting the requirements of CSA-O325. Minimum 3/8" (9.5mm) U.N.O.

2.3 FASTENERS AND ANCHORS

.1 Screws and Nails: Galvanized steel; type and size suitable for application.

.2 Anchors: Galvanized steel

.3 Galvanized Coating for Interior High Humidity or Areas Exterior Work: Hot dip galvanized to ASTM A153/A153M.

.4 Galvanized Coating for Treated Wood: Hot dip galvanized to ASTM A153/A153M, Class A or B1 (G185) zinc coating.

2.4 MISCELLANEOUS ACCESSORIES

.1 Polyethylene: Sheet polyethylene, 10 mil / 0.25 mm thick.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 71 00: Verify existing conditions before starting work.

3.2 INSTALLATION

.1 Set members level and plumb, in correct position. Place horizontal members, crown side up.

.2 Construct curb members of single pieces.

.3 Place horizontal members, crown side up.

.4 Space furring at 600 mm / 24 inches on centre.

.5 Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

.6 Coordinate curb installation with installation of decking and support of deck openings, roofing vapour retardant and parapet construction.

3.3 ERECTION TOLERANCES

.1 Section 01 73 00: Tolerances.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Special fabricated cabinet units.

.2 Countertops.

.3 Cabinet hardware.

.4 Preparation for installing utilities.

1.2 RELATED SECTIONS

.1 Section 06 10 00 – Rough Carpentry

.2 Section 09 91 10 - Paint and Coatings

1.3 REFERENCES

.1 ANSI A135.4 - Basic Hardboard.

.2 ANSI A208.1 - Mat Formed Wood Particleboard.

.3 AWMAC (Architectural Woodwork Manufacturers Association of Canada) - Quality Standards.

.4 BHMA A156.9 - Cabinet Hardware.

.5 FS MMM-A-130 - Adhesive, Contact.

.6 HPMA (Hardwood Plywood Manufacturer's Association) HP - American Standard for Hardwood and Decorative Plywood.

.7 NEMA (National Electric Manufacturers Association) LD3 - High Pressure Decorative Laminates.

.8 NHLA (National Hardwood Lumber Association).

1.4 SUBMITTALS

.1 Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings: Submit shop drawings of finish carpentry indicating materials, thicknesses, sizes, finishes, wood species, grades, profiles, connection attachments, fastening methods, accessories, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable

.3 Product Data: Provide data on fire retardant treatment materials and application instructions.

.4 Provide instructions for attachment hardware, and finish hardware.

.5 Samples:

.1 Two of each colour, pattern, gloss, and texture of plastic laminate, in manufacturer's standard tag size.

.2 Two samples of laminated plastic joints, edging, cutouts and postformed profiles.

.3 Two 6 x 6 inch size samples, illustrating countertop finish and edge detail.

.4 One of each item of finish carpentry hardware.

1.5 MOCK-UP

.1 Shop fabricate the following mock-ups in location acceptable to Consultant:

.1 One mock-up of a base cabinet, shelf/coat rod and counter top for each type of surfacing specified, complete with hardware and shop applied finishes.

.2 Arrange for Consultant's review and acceptance; allow 48 hours after acceptance before proceeding with Work.

.3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 QUALITY ASSURANCE

.1 Execute Work of this Section by member of AWMAC, with 5 years' experience in finish carpentry Work of comparable complexity and scope. Submit proof of qualifications.

.2 Fabricate finish carpentry Work in accordance with AWMAC Quality Standards, Premium Quality materials and installation unless otherwise indicated. Perform Work in accordance with the definition of Good Workmanship as defined in the AWMAC Quality Standards.

.3 Remove and replace finish carpentry Work which does not conform to the AWMAC Quality standards or as amended by these Specifications.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 60 00 - Product Requirements.

.2 Protect work from moisture damage.

.3 Deliver, store, and handle finish carpentry in accordance with the AWMAC Quality Standards. Control the temperature and humidity in accordance with the AWMAC recommendations, before, during, and after finish carpentry delivery, and also during storage and installation.

.4 Cover finished plastic laminated work with heavy kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately before final inspection.

1.8 FIELD MEASUREMENTS

.1 Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

.1 Coordinate the work with plumbing and electrical rough-in, installation of associated and adjacent components.

1.10 EXTENDED WARRANTY

.1 Submit warranty for plastic laminate work of this Section in accordance with General Conditions, except that warranty period is extended to 2 years.

.1 Warrant against defects in material and workmanship including but not limited to opening of joints, cracking, shrinkage, warpage, and delamination of plastic laminate.
.2 Coverage: Complete replacement including affected adjacent Work.

PART 2 Products

2.1 COMPONENTS

.1 Lumber shall be in accordance with the Architectural Woodwork Manufacturers Association of Canada Standards Grade specified for the product being fabricated. Moisture Content shall be 6% to 12% for boards up to 2 inches (50.8 mm) nominal thickness, and shall not exceed 19% for thicker pieces.

.2 Veneers shall be in accordance with the Architectural Woodwork Manufacturers Association of Canada Standards requirements for its use and the Grades.

.3 Core shall be MDF meeting the requirements of Architectural Woodwork Manufacturers Association of Canada Standards.

.4 Veneer core plywood shall be a non-telegraphing hardwood manufactured with exterior glue.

.5 Plastic Laminate shall meet the requirements of the Architectural Woodwork Manufacturers Association of Canada Standards for its intended use.

.6 Edgeband:

.1 Veneer of the same species and cut as the exposed surfaces.

2.2 WOOD MATERIALS

.1 General: All materials under Work of this Section, including but not limited to, adhesives and mastics, are to have low VOC content limits.

.2 Concealed framing lumber: Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWS Custom Grade, S4S, average moisture content 7% +/- 2% at installation.

.3 Hardwood lumber: White oak with painted or stained finish to NHLA and AWS Premium Grade, S4S, average moisture content 7% +/- 2% at installation. Allow for white stained white oak, flat cut. Stain or paint colour to be determined.

.4 Softwood plywood: CSA O151-M; Douglas fir plywood, 19 mm unless indicated otherwise, (G2S).

.5 Veneered plywood: CSA O151-M; White oak plywood with stained finish (colour to be determined) , flat cut.

.6 Pressure treated plywood: No.2 or Better Grade treatable species free of checks, holes, loose knots, pitch, shakes, splits, wane and warp, or as allowed by sample acceptable to the Consultant, vacuum/pressure impregnated with copper based preservative in accordance with CAN/CSA-080 to a net retention of 650 kg./m^3, unless otherwise specified by preservative manufacturer. Thickness as indicated on drawings.

.7 Plastic laminate: Provide through colour plastic laminate conforming to ANSI/NEMA LD 3 where core sheets and face sheets are same colour, as follows:

- .1 Flatwork face sheet: 1.2 mm thick, heavy wear resistance.
- .2 Vertical interior face sheets: 0.8 mm thick.
- .3 Postformed face sheet: 0.8 mm thick.
- .4 Backing sheet: thickness to match face sheet, high pressure laminate, manufactured by same manufacturer as face sheet.
- .5 Plastic laminate: As manufactured by Arborite, Formica, Forbo, Nevamar, Pionite and Wilsonart.
- .6 Colours: To the later selection of the Consultant from manufacturer's standard colour range.

.8 Melamine Surfaced Particleboard: ANSI A208.1, Grade M2 particleboard with a melamine impregnated decorative paper thermofused onto the surface. Edging to be done in thin PVC to match melamine colour. 'Panval Thermofused Melamine Panels' by Uniboard Canada Inc. Colours as follows:

- .1 White for interior millwork surfaces.

.9 Solid Surfacing: 16mm thick sheet stock, provide with bevelled edge and all cutouts as required. 'Corian' solid surfacing by DuPont or approved alternative in 'Class E' colours as selected by Consultant. Installation and seam adhesives to be as recommended by solid surfacing manufacturer, colour matched to solid surfacing.

.10 Medium Density Fibreboard (MDF): ANSI A208.2; omnidirectional, light coloured with uniform density throughout 'Superior MDF' by G-P Flakboard Ltd. or 'Panfibre Excel MDF' by Uniboard Canada Inc., meeting the following minimum criteria:

.1 Density: 740 kg/m^3.

.2 Internal bond: 0.8 N/mm^2.

.3 Modulus of rupture: 30 N/mm^2.

.4 Modulus of elasticity: 3400 N/mm^2.

.5 Face screw holding: 1450 N.

.6 Core screw holding: 1300 N.

.7 Moisture content: 4-7%.

.11 Particle board core: ANSI A208.1, Grade M2 of thickness indicated. Particleboard to be bound with waterproof adhesive and meeting the following minimum criteria:

.1 Density: minimum 705 kg/m^3.

.2 Internal bond: 0.45 N/mm^2.

.3 Modulus of rupture: 14.5 N/mm^2.

.4 Modulus of elasticity: 2250 N/mm^2.

.5 Face screw holding: 1000 N.

.6 Edge screw holding: 900 N.

.12 Laminating adhesive: CSA O112 Series, water resistant type, low VOC content, selected by laminate manufacturer for intended end use.

.13 Draw bolts and splines: Type as recommended by fabricator.

.14 Nails and staples: Conforming to ASTM F1667; Size and type to suit application, galvanized for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.15 Bolts, nuts, washers, blind fasteners, lags and screws: Size and type to suit application. Stapling is not acceptable.

.16 Adhesive and bituminous mastic: Selected by the millwork fabricator with low VOC content.

.17 Miscellaneous metals: In accordance with Section 05 50 00.

.18 Finishing: In accordance with Section 09 91 00.

2.3 ACCESSORIES

.1 Adhesive: Type recommended by laminate manufacturer.

.2 Plastic Edge Trim: Extruded flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness; colour to match laminate.

.3 Fasteners: Size and type to suit application.

.4 Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; fasteners shall not be exposed except as noted.

.5 Concealed Joint Fasteners: Threaded steel.

.6 Kitchen accessory: The following is the minimum quality standard for the work of this Section. Alternatives maybe considered provided they are approved by Consultant prior to ordering of products:

.1 Pull out pentry system: Dispensa Kit with Chrome Wire Baskets by Richelieu. Width and height to suit.

.2 Corner cabinet storage system at base cabinet: Rev-A-Shelf Chrome Wire 2-tray Set by Richelieu. Size to suit.

.3 Drawer Mat: Non-slip mat by Richelieu. Colour Grey. Size to suit. Typical for all drawers.

2.4 HARDWARE

.1 Shelf Standards and Rests: Formed steel channels and rests, cut for fitted rests spaced at 1 inch centres; satin finish.

.2 Shelf Brackets: Formed steel brackets, formed for attachment with lugs; satin finish.

.3 The following hardware is the minimum quality standard for the work of this Section. Alternatives may be considered provided they are approved by Consultant prior to ordering of products.

.1 Drawer slides: Full extension, 8400 Series by Knape & Vogt.

.2 Pilasters: Clear anodized aluminum recessed shelf standards with 12 mm divisions, Model 233 by Knape & Vogt.

.3 Clips: Bright zinc plated, adjustable height shelf supports, Model 256 by Knape & Vogt.

.4 Cabinet hinges: Heavy duty, concealed 110 degree, clip, self closing, Model 75M3550 by Blum.

.5 Drawer and cabinet pulls: 10 mm dia. x 106 mm wide, stainless steel with matt finish, 115.61.601 by Hafele.

.6 Magnetic catches: Model 918 by Knape & Vogt.

.7 Locks: Cam locks/deadbolt locks complete with lock core by Hafele, type to suit application and installation.

2.5 FABRICATION

.1 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.

.2 Coordinate locations of concealed supports and blocking with other parts of Work.

.3 Provide cutouts for outlet boxes and other fixtures.

.4 Fabricate work in a manner which will permit expansion and contraction of the materials without visible open joints. Conceal joints and connections in wherever possible.

.5 Set nails and countersink screws, apply wood filler to indentations, sand smooth and leave ready to receive finish.

.6 Mitre exposed corners, no end grain shall be visible in completed installation.

.7 Fabricate units by solid surfacing manufacturer's certified or approved fabricator/ installer. Fabricate built-up profiles as indicated.

.8 Finish millwork in accordance with Section 09 91 00. Finished millwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.

.9 Shelving to cabinetwork to be adjustable unless otherwise noted.

.10 Recess shelf standards, unless noted otherwise. Stagger recessed shelf standards on opposite sides of divider.

.11 Do not exceed maximum 760 mm unsupported span for 19 mm thick shelving.

.12 House fixed shelving into gables and divisions.

.13 Shop assemble finish carpentry to accommodate delivery and handling and to ensure passage through building openings.

.14 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.15 Fabricate upper and lower cabinets from solid core white oak 3/4" thick in shaker style, finished with alkyd paint in accordance with Section 09 91 00.

.16 Fabricate vent hood enclosures and bookshelves from veneered plywood 3/4" thick, flat cut veneer in stain finish. Colour to be determined.

.17 Veneered plywood: Provide veneered plywood with hardwood edges and finished in clear matte finish in accordance with Section 09 90 00.

.18 Fabricate sills, screens, frames and moldings to profiles shown.

PART 3 Execution

3.1 EXAMINATION

.1 Verify existing conditions and verify site measurements before starting work.

.2 Verify adequacy of backing and support framing.

.3 Verify location and sizes of utility rough-in associated with work of this section.

.4 Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

.1 Install Work in accordance with AWS Quality Standards and tolerances for Architectural Woodwork. Set and secure finish carpentry in place, rigid, plumb, square, and level.

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.

.3 Coordinate cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures, in finish carpentry. Round internal corners of cut-outs and seal exposed cores.

.4 Form joints to conceal shrinkage.

.5 Install draw bolts and splines in laminated plastic counter top joints at maximum spacing 450 mm o.c., and 75 mm from edge. Make joints flush, hairline butt joints.

.6 Install finishing hardware accurately and securely in accordance with manufacturer's directions, adjust and clean.

.7 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.

.8 Apply bituminous coating over wood framing members in contact with masonry or cementitious construction.

.9 Melamine panels: Assemble melamine millwork using dowelled/wafered-and-glue construction. Installed melamine panels shall not show any exposed fasteners on finished/exposed surfaces.

.10 Install solid surfacing in accordance with manufacturer's instructions.

.11 Door frames:

- .1 Butt and cope internal joints of door frames to make snug, tight, joint. Cut right angle joints with mitred joints.
- .2 Fit backs of frames snugly to wall surfaces to eliminate cracks at junction of frame with walls.

.12 Fastening:

- .1 Coordinate wall securement, anchorage, and blocking for finish carpentry items.
- .2 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.3 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.4 Provide heavy duty fixture attachments for wall mounted cabinets.

.5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.13 Remove and replace damaged, marked, or stained finish carpentry.

3.3 ADJUSTING

.1 Adjust doors, drawers, accessories, etc., for smooth operation.

3.4 CLEANING

.1 Section 01 70 00 – Examination and Preparation

.2 Wash down surfaces:

.1 With a solution of mild detergent in warm water,

.2 Applied with soft, clean wiping cloths,

.3 Take care to remove dirt from corners, and

.4 Wipe surfaces clean.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for sheet membrane waterproofing Work in accordance with the Contract Documents.

1.2 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Formwork.

.2 Section 07 21 13 - Board Insulation.

.3 Section 33 46 13 - Foundation Drainage.

1.3 REFERENCES

.1 ASTM ASTM D570 Standard Test Method for Water Absorption of Plastics

.2 ASTM D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds

.3 ASTM D 1876 Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)

.4 ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

.5 ASTM D3767 Standard Practice for Rubber - Measurement of Dimensions

.6 ASTM D5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes

.7 ASTM E96 - Test Methods For Water Vapour Transmission of Materials.

1.4 SYSTEM DESCRIPTION

.1 Waterproofing System: Capable of resisting water and preventing moisture migration to interior.

1.5 SUBMITTALS FOR REVIEW

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide data for flexible flashings, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.

.3 Shop Drawings: Provide shop drawings of the entire sub-grade waterproofing system showing locations and extent of all waterproofing materials, waterstops,

and accessories including details of substrate joints, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, integration with air barrier system, and other termination conditions.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 01 78 10: Closeout Submittals

.2 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

.1 Perform Work in accordance with NRCA Waterproofing Manual.

.2 Manufacturer’s Qualifications: Sheet membrane waterproofing system manufacturer shall be ISO 9001 certified and demonstrate a minimum of fifteen (15) years continuous, successful experience in production of waterproofing membranes.

.3 Installer Qualifications: Sheet membrane waterproofing system installation shall be performed by one Contractor, approved by the waterproofing manufacturer, and shall have at least five (5) years of experience in work of the type required by this section.

.4 Manufacturer Technical Representatives: Membrane manufacturer shall provide trained direct company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conduct a final inspection upon successful completion of the installation.

.5 Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions, to coordinate this work with related and adjacent work, and to review special details.

1.8 MOCK-UP

.1 Construct mock-up horizontal and vertical waterproofed panel; to represent finished work including internal and external corners, seam jointing, attachment method, counter flashing cover.

.2 Locate where directed.

.3 Mock-up may remain as part of the Work.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Perform work only when weather conditions as well as ambient and substrate temperatures are within the limits established by the manufacturer of the sheet membrane waterproofing system. Do not apply waterproofing in snow, rain, or mist.

1.10 WARRANTY

.1 Section 01 78 36: Warranties.

.2 Provide five (5) year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 Products

2.1 MANUFACTURERS

.1 **Sika Corporation St. Louis**, 3400 Tree Court Industrial Boulevard, St. Louis, MO 63122; Phone: 800-325-9504; Fax: 800-551-5145; Email: info@greenstreak.com; usa.sika.com

.2 Source Limitations for Waterproofing System: Obtain primary sheet membrane waterproofing and all joint sealing and waterstop materials of each type required from a single manufacturer.

2.2 MEMBRANE MATERIALS

.1 SikaProof® A+12.

2.3 ACCESSORIES

.1 SikaProof® Tape A+: Self-Adhesive tape for pre-applied internal jointing, detailing, and transitions.

.2 SikaProof® ExTape-100: Self-Adhesive tape for post-applied SikaProof® A+ membrane seams

.3 SikaProof® Adhesive-22: Cementitious adhesive for application of SikaProof® A+ membrane to concrete

.4 Sika Drainage Mat 420: Consists of a polypropylene dimpled drainage core bonded with a non-woven geocomposite fabric on the top side, and a membrane protective film bonded to the bottom side.

.5 Leakmaster LVZ: Single Component moisture-cure water-swelling sealant used for detailing and penetrations

.6 Waterstop: Sika Greenstreak waterstops.

PART 3 Execution

3.1 EXAMINATION

.1 Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

.2 Verify items which penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

.1 Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

.2 Pre-Applied Application:

.1 The substrate shall be of sufficient stability to prevent movement during the concrete placement. Substrates must be regular and smooth with no gaps or voids larger than 0.5 in. Acceptable substrates include concrete, permanent or removable formwork, plywood, fleece, rigid protection board, or drainage composite.

.2 Horizontal Surfaces: The substrate must be free of loose aggregate and sharp protrusions. Avoid curved or rounded substrates. When installing over crushed stone or earth, ensure substrate is well compacted to prevent displacement of the substrate due to traffic or concrete placement. Substrate may be damp but standing water must be removed.

.3 Vertical Surfaces: Use a suitable substrate such as permanent or temporary formwork, plywood, rigid protection board, or drainage composite to provide membrane support.

.3 Post-Applied Applications:

.1 Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

.1 Cast In Place Concrete Substrates:

.1 Concrete must be cured for minimum 48 hours

.2 Fill form tie rod holes with concrete and finish flush with surrounding surface.

.3 Repair bug holes over 0.5 in in length and 0.25 in depth and finish flush with surrounding surfaces.

.4 Remove scaling to sound, unaffected concrete and repair exposed area

.5 Grind irregular construction joints to suitable flush surface

3.3 INSTALLATION

.1 Install membrane waterproofing in accordance with manufacturer's instructions for horizontal and vertical applictions.

.2 Roll out membrane. Minimize wrinkles and bubbles.

.3 Overlap edges by a minimum of 2 inches. Apply SikaProof Tape A+ at overlap of sheets. Roll with a hand roller to ensure a continuous bond is achieved.

.4 Install detail areas, such as pipe penetrations, pits, connections, expansion joints, and any other special details using the appropriate accessory products and in strict accordance with the manufacturer's installation instructions.

3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

.1 Place drainage board directly against membrane, butt joints, place to encourage drainage downward.

.2 Install drainage board in accordance with manufacturer's instructions.

.3 Place protection board directly against drainage panel butt joints.

3.5 FIELD QUALITY CONTROL

.1 Section 01 45 00: Quality Control.

.2 On completion of horizontal membrane installation, dam installation area in preparation for flood testing.

.3 Flood to minimum depth of 1 inch with clean water. After 48 hours, inspect for leaks.

.4 If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Consultant; repeat flood test. Repair damage to building.

.5 When area is proven watertight, drain water and remove dam.

3.6 PROTECTION OF FINISHED WORK

.1 Do not permit traffic over unprotected or uncovered membrane.

.2 Protect membrane from damage by adhering protection board over membrane surface. Scribe and cut boards around projections and interruptions.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Thermal insulation using rigid extruded polystyrene board at wall construction, perimeter foundation wall, and underside of slab.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-In-Place Concrete.

.2 Section 07 21 29 - Sprayed Insulation.

.3 Section 07 26 00 - Air Barrier, Air/Vapour Retarders.

.4 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing.

.5 Section 09 21 16 - Gypsum Board.

1.3 REFERENCES

.1 ASTM C578-13 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

.2 ASTM C591-13 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

.3 ASTM C1126-13a - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

.4 ASTM C1289-14 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

.5 ASTM E84-13a - Standard Test Method for Surface Burning Characteristics of Building Materials.

.6 ASTM E96/E96M-13 - Standard Test Methods for Water Vapor Transmission of Materials.

.7 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.8 CAN/ULC-S701-11 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.9 CAN/ULC-S704-11 - Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.10 CAN/ULC-S706-09 - Standard for Wood Fibre Insulating Boards for Buildings.

.11 Canadian General Standards Board (CGSB)

.1 CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 - Submittals Procedures.

.2 Product Data: Provide data on product characteristics, performance criteria, limitations, installation, and installation techniques.

.3 Manufacturer's Certificate: Certify that Products meets or exceed specified requirements.

.4 Submit one sample of each type of polystyrene board, 600 x 600 mm x indicated thickness, including the following required information printed on one face:

.1 Reference standard product meets

.2 Board Type, name of manufacturer or brand name

.3 CCMC Product Listing Number

.4 The following cautionary statement: Combustible product. Protection or thermal barrier is required in accordance with applicable building codes.

.5 Location where product is to be used.

.6 Sample of each type specified accessory and fastener.

1.5 QUALITY ASSURANCE

.1 Identification: each insulation board must be clearly labelled with the information listed in the manufacturer's applicable Product Data Sheet.

.2 Provide mock-up of proposed complete wall type assembly at Chapel. Confirm location on site with Consultant prior to mock-up. Mock-up may become part of the final construction if confirmed by Consultant. Otherwise, mock-up to be removed.

.3 Section 01 61 00 - Product Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING.

.1 Deliver, store and handle polystyrene foam insulation boards in accordance with manufacturer's printed instructions.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

1.8 SITE ENVIRONMENTAL REQUIREMENTS

.1 Apply polystyrene foam board insulation only when ambient climatic conditions (risk of rain, high humidity levels) and temperature of surfaces to be insulated are within acceptable limits to prevent risk of condensation. Install as per manufacturer’s written instructions.

.2 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of insulation materials.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS - INSULATION MATERIALS

.1 The Dow Chemical Company.

.2 Owens Corning Canada.

.3 GAF.

.4 Rockwool.

.5 Substitutions: Refer to Section 01 62 00 - Product Exchange Requirements.

2.2 INSULATION MATERIALS

.1 Rigid Insulation: Extruded Polystyrene Insulation: CAN/ULC-S701, Type 4, closed-cell type,conforming to the following:

.1 Compressive Strength: 207 kPa.

.2 Thermal Resistance: R-5 / inch.

.3 Water Absorption: 0.3% by volume maximum

.4 Board Size: 24” x 96” or 48” x 96”.

.5 Board Thickness: 3 inches.

.6 Board Edges: Shiplap

.7 Flame/Smoke Properties: to CAN/ULC-S102

.8 Product: STYROFOAM Brand Sm Extruded polystyrene foam insulation manufactured by the Dow Chemical Company.

.2 Batt Insulation: mineral wool insulation board. CAN/ULC S702, Type 1.

.1 Compressive Strength: 17 kPa at 10% & 28kPa at 25%.

.2 Thermal Resistance: R-4 / inch.

.3 Water Absorption: 0.08% by volume maximum

.4 Board Size: 24” x 96” or 48” x 96”.

.5 Board Thickness: 2.5, 3.5 & 5.5 inches.

.6 Flame/Smoke Properties: to CAN/ULC-S102

.7 Product: Rockwool Comfortbatt & Roxul Safe ‘N’ Sound.

.3 Semi-Rigid Insulation: Mineral wool insulation. CAN/ULC S102, Type IVB.

.1 Compressive Strength: 9.4 kPa at 10% & 26.2kPa at 25%.

.2 Thermal Resistance: R-4 / inch.

.3 Water Absorption: 0.08% by volume maximum

.4 Board Size: 24” x 48”

.5 Board Thickness: 2 & 4 inches.

.6 Flame/Smoke Properties: to CAN/ULC-S102

.7 Product: Rockwool Rockboard60.

.4 Metal Clad Roofing: Polyisocyanurate Insulation (Faced): CAN/ULC-S704, Type II, closed cell insulation conforming to the following:

.1 Compressive Strength (ASTM D1621): ≥ 20 psi.

.2 Thermal Resistance: R-8 / Inch.

.3 Water Absorption (ASTM C209): ≤ 1.5%.

.4 Board Size: 48” x 96”.

.5 Board Thickness: 2”, 3”, and 4”.

.6 Board Edges: Square.

.7 Flame/Smoke Properties: to CAN/ULC-S102

.8 Product: Energy Guard Polyiso Insulation manufactured by GAF.

.5 Under Slab: Moulded Polystyrene Insulation (EPS): CAN/ULC-S701, Type 2; polystyrene board, with the following characteristics:

.1 Compressive Strength: 110 kPa.

.2 Thermal Resistance: R-4.0 / inch.

.3 Water Absorption: 4%.

.4 Board Size: 48” x 96”.

.5 Board Thickness: 4”.

.6 Board Edges: Square.

.7 Flame/Smoke Properties: to CAN/ULC-S102.

2.3 ADHESIVE MATERIALS

.1 As per manufacturer’s recommendation

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 - Examination and Preparation.

.2 Examine substrates and do not proceed with installation until defects have been corrected.

.1 Ensure substrates are solid, fill materials are well compacted and drained, free of protrusions and true to plane (i.e. free of undulations), free of dust and debris of snow, ice, frost and ready to receive foam insulation boards.

3.2 INSTALLATION

.1 Compliance: comply with manufacturer's written instructions, recommendations and written specifications, including product Technical Bulletins, Product Catalogue installation instructions, product package installation instructions, and Product Data Sheets

.2 Coordinate adjacent, underlying and penetrating work which must be completed prior to insulation work or those that will be installed after insulation work.

.3 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.4 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.5 Keep insulation away from heat-emitting devices such as recessed light fixtures, as required by codes.

.6 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only foam insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.7 Use boards with ship lapped edges where joint overlap is required in single layer applications.

.8 Offset both vertical and horizontal joints in multiple layer applications.

.9 Fastening:

.1 Adhesive.

.2 Mechanical fastening:

.1 Fasten insulation boards using mechanical fasteners as per manufacturer's instructions.

.10 Temporarily protect installed insulation boards from inclement weather, excessive sunlight and other physical damages.

3.3 EXTERIOR WALLS AND ROOF/TYPICAL

.1 Install insulation board within horizontal continuous 'L' subgirt fastened with Iso-clips. Refer to Section 07 42 13 – Standing Seam Wall Panel and Section 07 61 13 – Standing Seam Metal Roofing.

3.4 UNDER SLAB/TUNNEL INSULATION

.1 Under slab/ramp application: Lay boards on level compacted fill.

3.5 CLEANING

.1 Upon completion of the installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Cellulose insulation applied to metal framing.

.2 Vapour retarder: Class II achieved at 1" thickness.

1.2 RELATED SECTIONS

.1 Section 03 30 00 – Cast-In-Place Concrete.

.2 Section 05 31 23 – Steel Roof Decking

.3 Section 05 40 00 – Cold Formed Metal Framing

.4 Section 07 26 00 – Air Barrier, Air/Vapour Retarders

.5 Section 08 44 13 – Glazed Aluminum curtain Walls and Skylight System.

.6 Section 09 21 16 – Gypsum Board

1.3 REFERENCES

.1 ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.2 ASTM C1014 - Spray-Applied Mineral Fibre Thermal or Sound Absorbing Insulation.

.3 ASTM D1622 - Test Method for Apparent Density of Rigid Cellular Plastics.

.4 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

.5 ULC (Underwriters Laboratories of Canada) - List of Equipment and Materials for:

- .1 Building Materials.
- .2 Fire Resistance.
- .3 Firestop Systems and Components.

.6 ITS (Intertek Testing Services) - Certification Listings.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

- .1 Preparation instructions and recommendations.
- .2 Storage and handling requirements and recommendations.

.3 Installation methods

.3 Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

.4 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Manufacturer with a minimum of ten years' experience manufacturing products in this section shall provide all products listed.

.2 Installer Qualifications: Products listed in this section shall be installed by a single organization with at least five years' experience successfully installing insulation on projects of similar type and scope as specified in this section.

1.6 REGULATORY REQUIREMENTS

.1 Conform to applicable code for flame and smoke ratings, concealment, and overcoat requirements.

1.7 MOCK-UP

.1 Section 01 45 00 – Quality Control.

.2 Construct mock-up, 3 m long by 43 m wide, which includes wall construction, ceiling construction, window and frame.

.3 Locate where directed by Consultant.

.4 Mock-up will be used:

.1 To judge workmahsip, substrate preparation, operation of equipment and material application

.5 When accepted, mock-up will demonstrate minimum standard of quality required for work.

.6 Mock-up may remain as part of the Work.

.7 Do not proceed with remaining work without written approved from consultant.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Section 01 61 00 – Product Requirements.

.2 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

.3 Do not apply insulation when substrate temperatures are under manufacturer's written recommendations.

.4 Surfaces must be dry prior to application of spray foam. Excess humidity may cause poor adhesion, and result in product failure.

.5 To avoid overspray, product should not be applied when conditions are windy.

1.9 SEQUENCING

.1 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 Products

2.1 MANUFACTURERS

.1 Acceptable Manufacturer:
CertainTeed Corp., Insulation Group
750 E. Swedesford Rd. P. O. Box 860; Valley Forge, PA 19482-0860
Toll Free Tel: 800-233-8990; Fax: 610-341-7940.

.2 Substitutions: Refer to Section 01 62 00 – Product Exchange Requirements.

2.2 MATERIALS

.1 Insulation: HFC-blown type Closed Cell Foam: medium-density, MDI- based polyurethane thermoset rigid foam.

.1 Physical and Mechanical Properties:

.1 Corde Density: 1.9-2.4 pcf when tested in accordance with ASTM D 1622.

.2 Thermanl Resistance (aged): 5.8 less than or equal to 2-1/2 inches / 6.4 when greater than 2-1/2 inches when tested in accordance with ASTM C 518 at 75 degrees F, (h-ft2- degrees F)/Btu.

.3 Thermal Resistance (initial): 6.4 when tested in accordance with ASTM C 518 at 75 degrees F, (h-ft2- degrees F)/Btu.

.4 Closed Cell Content: 88-95 percent when tested in accordance with ASTM D 2842.

.5 Compressive Strength: Greater than 25 psi when tested in accordance with ASTM D 1621.

.6 Tensile Strength: 23 psi when tested in accordance with ASTM D 1623.

.7 Water Absorption: Less than 2 percent by volume when tested in accordance with ASTM D 2842.

.8 Dimensional Stability: Less than 9 percent by volume when tested in accordance with ASTM D 2126 at 75 degrees F/95 percent RH, 28 Day.

.9 Water Vapor Transmission: 1.3 perm/inch when tested in accordance with ASTM E 96.

.10 Air Permeability: 0.013 when tested in accordance with ASTM E 283 at 1 inch thickness, L/s/m2.

.11 Fungi Resistance: Pass, with no growth when tested in accordance with ASTM C 1338.

.2 Fire performance

.1 Flame Spread: Less than 25 when tested in accordance with ASTM E 84.

.2 Smoke: Less than 450 when tested in accordance with ASTM E 84.

.3 Thermal Performance (aged): Tested in accordance with ASTM C 518 and/or ASTM C 177 at 75 degrees F (24 degrees C) mean temperature.

.1 Thickness 2 inches (51 mm), R-Value 11.6 (h-ft2-degreesF)

2.3 ACCESSORIES

.1 Primer: As required by manufacturer's written installation recommendations.

.2 Insulation Surface Sealer: As required by manufacturer's written installation recommendations.

PART 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation.

.2 Verification of existing conditions before starting work.

.3 Verify that surfaces are clean, dry, and free of matter that may inhibit adhesion.

.4 Verify other work on and within spaces to be insulated is complete prior to application.

.5 Verify that mechanical and electrical services in ceilings, walls and floors have been installed and tested and, if appropriate, verify that adjacent materials are dry and ready to receive insulation.

.6 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

.7 Mask and protect adjacent surfaces from overspray or damage.

3.2 APPLICATION

.1 Apply insulation in accordance with manufacturer's instructions.

.2 Apply insulation to a uniform monolithic density without voids.

.3 Apply to achieve a thermal resistance R value of 13.

3.3 FIELD QUALITY CONTROL

.1 Inspection will include verification of insulation and density.

3.4 PROTECTION OF FINISHED WORK

.1 Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation methods supplementing primary air seal materials and assemblies.

.2 Labour, products, equipment, and services necessary for:

.1 Self-adhered water resistive air barrier.

.2 Self-adhered air/vapour barrier.

.3 Sheet and sealant material for controlling vapour diffusion.

1.2 RELATED SECTIONS

.1 Section 03 30 00 – Cast-In-Place Concrete.

.2 Section 05 40 00 – Cold Formed Metal Framing.

.3 Section 07 13 00 – Sheet Membrane Waterproofing

.4 Section 07 14 00 – Fluid Applied Waterproofing

.5 Section 07 21 13 – Board Insulation.

.6 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing.

.7 Section 07 62 00 – Sheet Metal Flashing and Trim.

.8 Section 07 84 00 – Firestopping.and Smoke Seal.

.9 Section 07 92 00 – Joint Sealants.

.10 Section 08 44 13 – Glazed Aluminum Curtain Walls and Skylight System.

.11 Section 09 21 16 – Gypsum Board.

.12 Section 09 91 10 – Painting and Coatings.

1.3 REFERENCES

.1 ASTM E2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

.2 ASTM E2178: Standard Test Method for Air Permeance of Building Materials.

.3 ASTM E283: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.4 E1677 Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

.5 ASTM E330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

.6 ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.7 ASTM E96: Water Vapor Transmission of Materials.

.8 CGSB 37-GP-56M: Membrane, Modified, Bituminous, Prefabricated, and Reinforced

.9 ASTM D882: Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

.10 ASTM D903: Standard Test Method for Peel or Striping Strength of Adhesive Bonds.

.11 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 DEFINITIONS

.1 Air Barrier: A continuous network of materials and joints providing air tightness, with adequate strength and stiffness to not deflect excessively under air pressure differences, to which it will be subjected in service. It can be comprised of a single material or a combination of materials to achieve the performance requirements.

.2 Vapour Retarder: A material or assembly of materials that resists water vapour diffusion through it.

1.5 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures.

.2 Product Data: Submit one copy of manufacturer’s Product Data indicating:

.1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.

.2 Product transportation, storage, and handling.

.3 Samples: Submit following samples:

.1 One 300 x 300 mm sample of vapour retarder/barrier.

.4 Installation Data: Manufacturer's special installation requirements, including preparation, installation requirements and techniques, product storage and handling criteria.

1.6 QUALITY ASSURANCE

.1 Submit document stating the applicator of materials membranes specified in this section is qualified by the manufacturer as suitable for the execution of the Work.

.2 Perform Work in accordance with manufacturer’s written instructions and this specification.

.3 Maintain one copy of manufacturer’s written instructions on site.

.4 Allow access to Work site by manufacturer’s representative.

.5 Components used shall be sourced from one manufacturer.

1.7 MOCK-UP

.1 Construct on 10 m^2 mock-up of each type vapour retarder in location acceptable to Consultant indicating as a minimum one lap joint, one inside corner, one window interface, and one electrical box.

.2 Arrange for Consultant's review and acceptance.

.3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.8 SITE CONDITIONS

.1 Ambient Conditions:

.1 Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

1.9 WARRANTY

.1 Section 01 78 36 - Warranties.

.2 Provide manufacturer's standard 10 year material warranty to include coverage for failure to meet specified requirements.

.3 Warranty: Include coverage of installed sheet materials which fail to achieve air tight seal, exhibit loss of adhesion or cohesion, or do not cure.

Part 2 Products

2.1 MANUFACTURERS

.1 Henry Company
999 N Sepulveda Blvd, Suite 800
El Segundo, CA 90245
1-800-598-7663

.2 GCP Applied Technologies, Inc,
62 Whittemore Avenue
Cambridge, MA 02140
1-866-333-3726

.3 Substitutions: Refer to Section 01 62 00 – Product Exchange Requirements.

2.2 MATERIALS

.1 Vapour Retarder – Sloped Roof: Roof Underlayment membrane (Basis of Design).

.1 Self-adhering sheet roofing membrane underlayment.

.1 Basis of Design: Grace Ultra roofing underlayment, extended hight-temperature.

.2 Colour: Gray-black.

.3 Thickness: 30 mils (.76 mm).

.4 Moisture Vapour Permeance (ASTM E96): <0.1.

.5 Nail Sealability (ASTM D1970): PASS

.2 Air and Vapour Membranes (Basis-of-Design):

.1 Primary sheet air/vapour barrier membrane shall be Blueskin SA manufactured by Henry; an SBS modified bitumen, self-adhering sheet membrane complete with a blue engineered thermoplastic film. For application temperatures down to 10 degrees F use Blueskin SA LT. Membrane shall have the following physical properties:

.1 ASTM E2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies,

.2 Air leakage: <0.0001 CFM/ft² @1.6 lbs/ft2 to ASTM E2178 and ASTM E283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft2 for 1 hour and gust wind load pressure of 62.8 lbs/ft2 for 10 seconds when tested at 1.6 lbs/ft2 to ASTM E331,

.3 Vapour permeance: 0.03 perms to ASTM E96 (Desiccant Method),

.4 Vapour permeance: 0.08 perms to ASTM E96 (Wet Cup Method),

.5 Membrane Thickness: 0.0394 inches (40 mils),

.6 Low temperature flexibility: -22 degrees F to CGSB 37-GP-56M,

.7 Elongation: 200% to ASTM D412-modifed,

.8 Meets CAN/CGSB-51-33 Type I Water Vapour Permeance requirements

Part 3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that existing substrates to receive membrane are clean, dry, sound, smooth, and continuous.

.3 Coordinate installation with work of other Sections to achieve a tight building envelope.

3.2 VAPOUR RETARDER OR AIR AND VAPOUR RETARDER / AIR BARRIER / VAPOUR BARRIER

.1 Ensure services are installed and inspected prior to installation.

.2 Use sheets of largest practical size to minimize joints.

.3 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

.4 Ensure continuity is maintained at junctures with other materials.

3.3 FIELD QUALITY CONTROL

.1 Inspect continuity immediately prior to installation of subsequent construction. Repair punctures rips and tears to ensure continuity.

.2 Where punctures and tears are extensive, replace entire damaged section.

.3 Do not cover or permit to be covered any portion of work until it has been inspected by Consultant.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Preformed metal wall and roofing system including underlayment, insulation, metal panel clip system, metal panels, sub framing and accessories including associated flashings, closures and sealants.

.2 Snow retention guard and clamps.

1.2 RELATED SECTIONS

.1 Section 05 12 00 - Structural Steel

.2 Section 05 40 00 - Cold Formed Metal Framing

.3 Section 07 21 13 – Board Insulation

.4 Section 07 21 29 – Sprayed Insulation

.5 Section 07 26 00 – Air Barrier, Air/Vapour Retarders

.6 Section 07 62 00 – Sheet Metal Flashing and Trim

.7 Section 07 71 23 – Gutters and Downspouts

.8 Section 07 92 00 – Joint Sealants

.9 Section 08 44 13 – Glazed Aluminum Curtain Walls and Skylight System

1.3 REFERENCES

.1 List reference standards that are included within the text of this section. Edit the following as required for project conditions.

.2 ASTM B69-16 (or latest edition) – Architectural Rolled Zinc - Types 1 and 2 – Standard Specification for rolled zinc.

.3 RHEINZINK Division 7 Binder: latest edition.

.4 RHEINZINK Material and Processing Guidelines: latest edition

.5 SMACNA – Architectural Sheet Metal Manual; latest edition; Chapter 7 as a minimum standard or these specification and details where they exceed.

1.4 WALL PANELS DESIGN REQUIREMENTS

.1 Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall in accordance with OBC.

.2 Maximum Allowable Deflection of Panel: 1/240th of span.

.3 Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.

.4 Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

.5 Continuity of thermal and air-vapour barriers at building enclosure..

1.5 ROOFING DESIGN REQUIREMENTS

.1 Design roof system to resist:

.1 Snow loads and snow build-up and rain load, expected in this geographical region NBCC climatic data, 50 year probability

.2 Wind loads, positive and negative, expected in this geographical region NBCC climatic data, 50 year probability

.3 Dead load of roof system.

.4 If the roof system is to be designed as a shear diaphragm, then the factored shear design loads “Q” and the flexibility factors “F” must be shown on the structural drawings.

.2 Deflection of the roof system is not to exceed 1/240th of the span for the specified live loading.

.3 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

.1 Temperature Change (Range): 20 deg C, ambient; 40 deg C, material surfaces

.4 Continuity of thermal and air-vapour barriers at building enclosure..

1.6 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures

.2 Product Data: Provide maintenance data for cleaning and maintenance of panel finishes for incorporation into Closeout Manual.

.3 Fabricator and Installer’s references demonstrating completed projects (3) using “natural metal” roof and wall panels.

.4 Shop Drawings:

.1 Show layouts of tiles on all walls, roof plans, location of all roof penetrations, details of tile terminations, edge conditions, joints, corners, tile profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field assembly work. Provide actual dimensions to the greatest extent possible.

.1 Details for forming sheet metal components including dimensions.

.2 Details for joining and securing sheet metal components, including wood sub framing, clip spacing, fastener requirements, and other attachments.

.3 Details of termination points and assemblies, including fixed points.

.4 Details of expansion joints, including showing direction of expansion.

.5 Details of roof penetrations.

.6 Details of edge conditions, including eaves, ridges, valleys, rakes, crickets and counter flashings.

.7 Details of special conditions, integrating mechanical, electrical and plumbing conditions.

.8 Details of connections to adjoining work

.9 Details of the following accessory items, at a scale of not less than 1 ½ inches per 12 inches:

.1 Flashing and Trim

.2 Gutters including outlet locations and expansion joints

.3 Leaf guard.

.4 Downspouts

.5 Snow Retention System.

.2 Drawings shall be signed and sealed by a Professional Engineer, attesting to the ability of the wall and roofing assemblies to withstand the required loads as per OBC.

.5 Samples: Submit two samples of panel, 75 x 75 mm in size illustrating finish colour, sheen, and texture.

1.7 QUALITY ASSURANCE

.1 Manufacturer of roof system, and installer shall demonstrate at least five years' experience in projects similar in scope.

.2 Fabricator References: Company specializing in zinc or copper fabrication with minimum 10 years of experience. Fabricator to submit list of (3) completed project with references for fabricating "natural metal" roof and wall panels of similar scope and complexity.

.3 Installer References: Company specializing in zinc or copper fabrication with minimum 10 years of experience. Installer to submit list of (3) completed "natural metal" roof and wall installations (zinc or copper) of similar scope and complexity.

.4 Same qualified fabricator and installer are responsible for Section 07 42 13 Standing Seam Zinc Wall Panels and Roofing, Section 07 62 00 Sheet Metal Flashing and Trim and Section 07 71 23 Gutter and Downspouts.

.5 Product Source: All zinc product to be supplied by same manufacturer fabricator.

1.8 MOCK-UP

.1 Section 01 45 00 – Quality Control

.2 Provide mock up of built-in gutter system of sufficient size to demonstrate the following:

- .1 Roof and Wall edge connection.
- .2 Roof and Wall standing seam.
- .3 Flashing, counter flashing and trims.
- .4 Underlayment and waterproofing.
- .5 Gutter and connection to downspout.

.3 Provide mock-up of 3 m long by 3 m wide, which includes roof and wall system, attachments to building frame, associated vapour retarder, air seal materials sealants and seals, and related insulation. Mark up location to be determined and may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND PROTECTION

.1 Store components and materials in accordance with panel manufacturer's recommendations and protect from elements.

.2 Protect prefinished steel during fabrication, transportation, site storage and erection, in accordance with CSSBI Standards.

1.10 WARRANTY

.1 Section 01 78 36 – Warranties

.2 For work in this section, warranty by installer against defects or deficiencies in materials or workmanship shall be for a period of one year from date of substantial completion.

PART 2 Products

2.1 MANUFACTURERS

.1 RHEINZINK America, Inc.
Woburn, MA 01081
Tel: (781) – 729-0812

Regional Sales Manager: Richard Stickland. Tel: 647-292-0401

.2 Snow Retention Warehouse
2 Chisholm Court, Ajax, ON.
Tel: 1-855-888-6869

.3 Substitutions: Refer to Section 01 62 00 – Product Exchange Procedures

2.2 FRAMING

.1 Provide additional sub framing components for wall and roof: Galvanized "Z" angles on ISO clips and thermal isolator.

.1 Provide all hats, zees or similar light-gauge metal profile to provide air space as indicated on the drawings. All framing members and components shall be fabricated from ASTM A525 G90 (or latest edition) galvanized sheet steel. Provide all secondary framing members as required for panel installation whether indicated or not on the architectural drawings.

.2 Coordinate wall panel sub framing support with cold-formed metal framing, plywood sheathing, exterior gypsum sheathing and furring, for complete structural support for performances indicated.

2.3 MATERIALS

.1 Zinc Alloy Sheet/Coils:

.1 ZinTitanium Zinc Alloy whose base is electrolytic high grade with a 99.995 % Zn degree of purity and alloying additives of 0.08% - 1.0% copper and 0.07% - .12% titanium, .001% - .015% aluminum in accordance with ASTM B69-16 (or latest edition) – Architectural Rolled Zinc - Type 1 and Type 2.

.2 Panel Thickness: 0.8mm (22 ga).

.3 Panel Width: 19.7".

.4 Panel Seam Height (double lock standing seam): 1 ½".

.5 Seam Spacing: +/- 15 1/2", +/-5" and +/-8". Refer to elevations. Final seam spacing and arrangement is to be confirmed at shop dwg.

.6 Flashing Thickness: 0.8mm (24 ga.)

.2 Breather: RHEINZINK AIR-Z.

.3 Water Proofing Underlayment: As specified in Section 07 26 00.

.4 Clip System:

.1 Provide stainless steel concealed clips and fasteners; supplied in accordance with manufacturer's recommendations and to meet the load requirements and confirmed by engineering calculations. When using AIR-Z by RHEINZINK or Enkamat (7008 or 7010) by Bonar, Enka, NC. Use clips that are ¼" taller than the seam or a shim between the clip and the AIR-Z or Enkamat.

.2 Roof Fasteners: As specified by manufacturer , to resist wind uplift and sliding snow forces.

.5 Insulation: As specified in Section 07 21 13 – Board Insulation.

.6 Solder: Lead solder containing 50% tin and 50% lead in accordance with ASTM B32 – 08 (or latest edition) or lead-free solder. Flux: Felder ZD-Pro or equal.

.7 Sealants:

.1 Joint Sealant: DOW 795, or other documented pH neutral sealant

.2 Backer rod shall be extruded polyethylene foam as DOW ETHAFOAM SB or equal.

.8 Provide all components necessary for a complete, functional, weatherproof assembly including, but not limited to, trims, copings, fascias, sills, flashings, counter flashings, door frame trim, corner units, clips, wall caps, copings, sealants, closures and fillers. Metal materials shall match panels and be zinc compatible.

2.4 PANEL FINISHES

.1 RHEINZINK – prePATINA: Graphite-grey.

2.5 SNOW RETENTION

.1 S-5 Clamps and Dural Guard Snow Retention System.

.2 Provide all components necessary for a complete and functional system.

.3 All finishes to be powder coated to match metal panel roofing.

2.6 FABRICATION

.1 Fabricate sheet metal components to comply with dimensions, profiles, gauges and details as shown on the shop drawings, including fascia and soffit panels and all companion flashing.

.2 Fabricate all components of the system in the factory, ready for field installation.

.1 Standing-Seam wall Panels: Form standing-seam pans from continuous metal sheets, with male & female double lock standing seam panel edges on two sides with a finished seam height of 1.5 inch unless otherwise noted.

.2 Apply bituminous coating (for wall panels), backside coated zin (for roof panels) or other permanent separation materials on concealed panel surfaces where panels would otherwise be indirect contact with substrate materials that are non-compatible or could result in corrosion or deterioration of either material or finishes.

.3 Fabricate sheet metal wall panels to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.

.1 Lay out sheet metal wall panels so cross seams, when required, are made in direction of flow with higher pans overlapping lower pans. Stagger cross seams.

.2 Form and fabricate sheets, seams, strips, cleats, edge treatments, integral flashing, and other components of metal wall to profiles, patterns, and drainage arrangements shown and as required to resist water infiltration without excessive use of sealants (dry joints) while also allowing any water infiltration behind the wall panels to weep out.

.4 Fabricate sheet metal roofing panels to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form

exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.

.1 Form and fabricate sheets, seams, strips, cleats, edge treatments, integral flashing, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required to resist Water infiltration without excessive use of sealants (dry Joints) while also allowing any water infiltration behind the roof panels to weep out.

.5 Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, and filled with non-acidic sealant (concealed within joints) if determined to be necessary for weather-tight detail (dry joints are often acceptable).

.6 Sealant Joints: Where movable, non-expansion-type joints are indicated or required to produce weather tight seams, form metal to provide for proper installation of elastomeric sealant in compliance with SMACNA standards. In general, panel joints are intended to be dry, sealant-free, to facilitate air movement and drying behind the wall and roof panels.

PART 3 Execution

3.1 EXAMINATION

.1 Examine work of other Sections upon which work of this Section depends.

.2 Report all discrepancies to consultant before beginning work on the wall and roof system.

3.2 FIELD FABRICATION

.1 Form panels and flashings in shop to greatest extent possible. Field modify only as necessary.

.2 Ensure material temperature has moderated above 48 degrees F. prior to field fabrication.

.3 Cut prefabricated zinc panels, and flashing with smooth (non-serrated) blade shears and snips. Bend zinc so that there are properly sized radius bends. Inspect initial panel and flashing bends to ensure material cracking has not occurred.

.4 Form rounded cuts and notches as made by MASC notching tool and demonstrated during zinc manufacturer fabrication training. Rounded cuts & notches are also possible by cutting to a predrilled hole.

3.3 INSTALLATION

.1 Comply with manufacturer’s recommendations and instructions, except as otherwise shown or specified,

.2 Install work to be truly straight and square or conform to curvilinear geometry indicated on drawings.

.1 Fabricate and install work with lines and corners of exposed units true and accurate.

.2 Form exposed faces free of buckles, excessive waves, and avoidable tool marks considering temper and reflectivity of metal.

.3 Shim and align panel units within installed tolerance of ¼ inch in 20' –0"

.4 All seams shall be of uniform appearance and dimensions, straight and level with minimum exposure of solder and sealant.

.5 Except as otherwise shown, fold back sheet metal to form a hem on concealed side of exposed edges.

.6 Form all seams to be weatherproof, leaving room for expansion and contraction with specified and required tolerances.

.7 Comply with RHEINZINK Division 7 Binder; latest edition and SMACNA Architectural Sheet Metal Manual; latest edition, for flashings and sheet metal work.

.3 Conceal fasteners and expansion provision where possible in exposed work, and locate so as to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation

.4 To avoid material tearing, provide cuts with rounded notching tool or cut to pre-drilled hole. Only use smooth edge (non-serrated) shears and snips for zinc cutting.

.5 Provide indirect attachment of exposed zinc with concealed "keeper" whenever possible. Avoid exposed and direct fastening especially at lap locations to allow movement

.6 Provide work as indicated on approved shop drawings

.1 Form and fabricate sheets, seams, strips, cleats, edge treatments, integral flashings, and

.2 other components of metal wall cladding to profiles, patterns, and drainage arrangements

.3 shown and as required for water shedding construction. Ensure that all shop & field

.4 fabricated bends have an acceptable "rounded" or radius bend. NO SHARP BREAKS.

.7 Separate non-compatible materials with a rubberized asphalt underlayment.

.8 Install work to meet specified performance requirements.

3.4 CLEANING

.1 Clean exposed panel surfaces in accordance with manufacturer's instructions.

.2 Remove protective film (if any) from exposed surfaces of metal roofing promptly upon installation (or prior if film covers any concealed seam areas) with care to avoid damage to finish and in accordance with manufacturer's recommendations.

.3 Damaged units: Replace panels and other components of the work that have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair.

.4 Clean exposed metal surfaces of substances that would interfere with uniform oxidation and weathering and as recommended by panel manufacturer and maintain in a clean condition during construction. Never apply cleaner directly to zinc surface.

.5 Ensure that cleaning by other trades working in proximity to zinc installation is in accordance with the recommendations of the zinc manufacturer.

.6 For more complete instructions, please refer to RHEINZINK cleaning recommendations.

.7 Replace damaged panels and components that, in opinion of the Consultant cannot be satisfactorily repaired.

.8 Upon completion of the work, Contractor shall remove from the site all equipment and materials used on the work as well as any debris resulting from the operations.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for flashing and sheet metal Work in accordance with the Contract Documents.

1.2 RELATED SECTIONS

.1 Section 06 10 00 – Rough Carpentry

.2 Section 07 26 00 – Air Barrier, Air/Vapour Retarers

.3 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing

.4 Section 07 71 23 – Gutters and Downspouts.

.5 Section 08 44 13 – Glazed Aluminum Curtain Walls and Skylight System.

1.3 REFERENCES

.1 AISI - (American Iron and Steel Institute) - Stainless Steel - Uses in Architecture.

.2 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.3 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM B32 - Solder Metal.

.5 ASTM D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

.6 ASTM D4586 - Asphalt Roof Cement, Asbestos-Free.

.7 FS O-F-506 - Flux, Soldering, Paste and Liquid.

.8 NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual.

.9 SMACNA - Architectural Sheet Metal Manual.

1.4 SUBMITTALS

.1 Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings: Indicate material colour profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

.3 Submit two (2) samples 300 mm long in size illustrating metal finish colour.

1.5 MOCK-UP

.1 Refer to mock up requirement in Section 07 42 15 Standing Seam Zinc Wall Panels and Roofing. .

1.6 QUALITY ASSURANCE

.1 Perform work in accordance with SMACNA standard details and requirements.

1.7 QUALIFICATIONS

.1 Fabricator and Installer (for zinc flashing and galvanized steel flashing):

.1 Same qualified fabricator and installer are responsible for Section 07 42 13 Standing Seam Zinc Wall Panels and Roofing, Section 07 62 00 Sheet Metal Flashing and Trim and Section 07 71 23 Gutter and Downspouts.

.2 Product Source: All zinc product to be supplied by same manufacturer and fabricator.

.2 Fabricator and Installer (for lead coated copper flashing):

.1 Company specializing in **Heritage Roofing** with five (5) years documented experience of similar cedar roofing projects.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

.2 Prevent contact with materials which may cause discolouration or staining.

1.9 COORDINATION

.1 Section 01 31 00 – Project Managing and Coordination.

.2 Supply and install backflashings, vent flashings, vented z-girts, counter flashings and other as noted items in conjunction with roofing contractor. Ensure that flashings are not installed until after installation and inspection of roofing membrane base flashings. Obtain approval from Consultant to proceed prior to installing flashings.

1.10 WARRANTY

.1 At no cost to the Owner, remedy any Work defects in Work, including Work of this and other section, due to faults in materials and/or workmanship provided under this section appearing within a period of two (2) years from date of Substantial Performance.

PART 2 Products

2.1 SHEET MATERIALS

.1 Zinc:

.1 Titanium Zinc Alloy whose base is electrolytic high grade with a 99.995 % Zn degree of purity and alloying additives of 0.08% - 1.0% copper and 0.07% - .12% titanium, .001% - .015% aluminum in accordance with ASTM B69-16 (or latest edition) – Architectural Rolled Zinc - Type 1 and Type 2

.2 Product: Rheinzink - prePATINA

.3 Colour: Graphite Grey

.4 Minimum Flashing Thickness: 0.8 mm (22 ga.)

.2 Lead Coated Copper:

.1 Lead Coated Copper: ASTM B101 Type 1, Class A, soft temper.

.1 16 oz per sq. ft. (0.0216-inch thick) (0.55mm) except as otherwise noted.

.2 Step Flashing Material

.1 Pre-Coated Galvanized Steel: ASTM A653/A653M, G90 zinc coating; 24 gauge core steel, shop primed and thickness of 0.025mm pre-coated with nominal coating colour as selected by consultant.

.3 Prepainted Sheet Steel:

.1 Galvanized sheet steel, 0.60 mm minimum base steel thickness, pretreated, primed and finish coated with nominal coating thickness of 0.025 mm;

.2 Colour to be determined.

.4 Aluminum Flashing:

.1 Aluminum sheet: ASTM B209 and ANSI H35.1 AA 1100 aluminum alloy, H14 temper, minimum 3.0 mm thick.

.2 Finish: Exposed to view: Colour to be determined, Concealed: Mill finish.

2.2 ACCESSORIES

.1 Fasteners: Non-corrosive metal compatible with sheet metal with soft neoprene washers.

.2 Cleats and edge strips: non-corrosive metal compatible with sheet metal thickness as required to provide rigid support and positive securement for metal flashings.

.3 Underlayment:

.1 ASTM D226 D2178, No. 15 asphalt saturated roofing felt. FS L-P-512, 0.15 mm, 6 mil polyethylene. (for galvanized steel)

.2 Rheinzink Air-Z and Grace Ultra (for zinc)

.3 Asphalt saturated felt weighing not less than 30 lbs per 100 square feet. (for lead coated copper)

.4 Slip Sheet: Mini9mum 4-lb. red rosin sized building paper (for galvanized steel and lead coated copper)

.5 Primer: Zinc chromate type (for galvanized steel)

.6 Sealant:

.1 Alkali resistant asphalt based enamel specified in Section 07 92 00 – Joint Sealants. Dymeric manufactured by TREMCO. Colour selected by Consultant. (for galvanized steel).

.2 Dow 795 structural silicone (for zinc).

.3 One-part, copper compatible elastomeric polyurethane, polysulfide, butyl or silicone rubber sealant as tested by sealant manufacturer for copper substrates (for lead coated copper)

.7 Protective Backing Paint: Back paint metal surfaces in contract with cement, concrete, masonry, plaster or dissimilar metals with heavy coat of bituminous paint.

.8 Reglets: Recessed type.

.9 Flux:

.1 FS O-F-506 (for galvanized steel).

.2 Felder ZD-Pro or equal (for zinc)

.3 Muriatic acid neutralized with zinc or approved brand of soldering flux. (for lead coated cooper)

.10 Solder:

.1 Lead solder containing 50% tin and 50% lead in accordance with ASTM B32 – 08 (or latest edition) or lead-free solder (for zinc).

.2 ASTM B 32; Provide 50-50 tin/lead or lead free alternative of similar or greater strength solder. Killed acid flux. (for lead coated copper)

2.3 FABRICATION (for Zinc Flashing)

.1 Fabricate zinc flashing & trim to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.

.1 Lay out sheet metal flashing & trim work so cross seams, when required, are made in direction of flow with higher profile overlapping lower profile. Stagger cross seams when aesthetics are critica

.2 Form and fabricate sheets, seams, strips, cleats, edge treatments, integral flashing, and other components of zinc flashing & trim to profiles, patterns, and drainage arrangements shown and as required to resist water infiltration without excessive use of sealants (dry joints) while also allowing any water infiltration behind the wall panels to weep out.

.2 Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with non-acidic sealant (concealed within joints).

.3 Sealant Joints: Where movable, non-expansion-type joints are indicated or required to produce weather tight seams, form metal to provide for proper installation of elastomeric sealant in compliance with SMACNA standards. In general, panel joints are intended to be dry, sealant-free, to facilitate air movement and drying behind the profiles whenever possible.

.4 Separating dissimilar products: Provide permanent separation materials on concealed profile surfaces where zinc profile would otherwise be in direct contact with substrate materials that are non-compatible or could result in corrosion or deterioration.

2.4 FABRICATION (for Galvanized Steel Flashing & Alum. Flashing)

.1 Shop fabricate metal flashing components to profiles indicated. Where flashings are required but not detailed follow applicable requirements of SMACNA Architectural Manual.

.2 Appearance: neatly and evenly lay out and install components. Exposed fastening devices not permitted.

.3 Compatibility: components shall be compatible with dissimilar metals and materials with which they are in contact or fastened to so as to prevent corrosion, staining and other detrimental effects. If required, treat or separate contact surfaces with inert and non-staining insulation material to achieve compatibility.

.4 Form sections true to shape, accurate in size, square, and free from distortion or defects.

.5 Fabricate continuous cleats of interlockable with sheet.

.6 Form pieces in longest possible lengths.

.7 Hem exposed edges on underside ½"; mitre and seam corners.

.8 Form material with flat lock seams.

.9 Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

.10 Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

.11 Fabricate flashings to allow toe to extend 2 inch over roofing. Return and brake edges.

.12 Seams: space seams uniformly at maximum 8'-0" o.c. unless otherwise indicated, use flat locked seams, lapped 1". Make horizontal seams in directions of water flow. Mitre and seal corners.

.13 Unless otherwise indicated, counter flashings shall completely cover base flashings.

.14 Furnish everything necessary for complete metal flashing installation, including clips and fastening devices.

2.5 FABRICATION (for Lead Coated Copper Flashing)

.1 Fabricate components to match existing profiles and sizes unless noted otherwise.

.2 Solder shop formed metal joints. After soldering, remove flux and wash clean.

.3 Fabricate corners in single units with minimum 18 inch legs.

.4 Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

.5 Form sections true to shape and size, square, and free from distortion.

.6 Make allowances for thermal movement when forming, installing, interlocking and soldering sheet metal. Work to avoid buckling, fullness of metal and straining of joints or seams. Max. length of flashing pieces; 10'-0". At vertical locations and horizontal planes greater than 30 inches, install metal in 4'-0" sections unless otherwise shown. Double back exposed edges at least ½ inch for appearance and stiffness.

.7 Hem exposed edges 1/2 inch on underside. Mitre and seam corners. Exposed new edges are not acceptable.

.8 Fabricate cleats and starter strips of same material as sheet metal.

.9 Where possible, shop fabricate flashing components in accordance with applicable requirements of manufacturer/supplier.

.10 Provide edge and drip strips where sheet metal extends over edges and where necessary to secure sheet metal work at eaves, gables, rakes and elsewhere. Where fastening is made in masonry or concrete, use lead sleeves to revive stainless steel screws. Install strips in continuous butted long lengths to allow metalwork to be hooked over lower edge by not less than ¾ inches.

.11 Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

2.6 SLEEVE FLASHING SYSTEMS

.1 Install sleeve flashing systems at penetrations through roof membrane. Install systems in accordance with manufacturer's directions and as follows:

- .1 Prior to installation of roofing membrane place bead of sealant around pipes, vent stacks and other components penetrating roof. Place bitumen protection cups over pipes into sealant.
- .2 Insulate between penetrating elements and sleeve with 25 mm thick fibrous insulation.
- .3 Prime contact surfaces with mastic cement; place flashing jackets onto roof membrane so that base flange is in contact with mastic cement placed on membrane.
- .4 Sweat solder or weld on rain collar.

PART 3 Execution

3.1 EXAMINATION

.1 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.

.2 Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

.1 Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION (for Zinc Flashing)

.1 Install work to be truly straight and square or conform to curvilinear geometry indicated on drawings.

.1 Fabricate and install work with lines and corners of exposed units true and accurate.

.2 Form exposed faces free of buckles, excessive waves, and avoidable tool marks considering temper and reflectivity of metal.

.3 Shim and align zinc flashing & trim within installed tolerance of ¼ inch in 20’ –0”

.4 All seams shall be of uniform appearance and dimensions, straight and level with minimum exposure of solder.

.5 Except as otherwise shown, fold back sheet metal to form an open hem (water check) on concealed side of exposed edges.

.6 Form all seams to be weatherproof, leaving room for expansion and contraction with specified and required tolerances.

.7 Comply with RHEINZINK RHEINZINK Division 7 Binder (latest edition); and SMACNA Architectural Sheet Metal Manual; latest edition for flashings and sheet metal work.

.2 Conceal fasteners and expansion provision where possible in exposed work, and locate so as to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

.3 Separate non-compatible materials with a rubberized asphalt underlayment.

3.4 INSTALLATION (for Lead Coated Flashing)

.1 Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction; install gutter with required slope.

.2 Fit flashings tight in place. Fit gutters to downspouts and flashings for watertight connections. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

.3 Miter, lap seam and close corner joints with solder. Seal seams and joints watertight.

.4 Install expansion joints at frequency recommended by manufacturer/suppliers written recommendations.

.5 Coordinate with installation of roofing system, roof accessories, and back flashing.

.6 Install flashing and sheet metal to manufacturers/suppliers written recommendations.

.7 Solder field formed metal joints.

.8 Secure flashings with concealed fasteners where possible.

.9 Apply plastic cement between metal and felt flashings.

.10 Fit flashings tight, with square corners and surfaces true and straight.

.11 Backpaint all metal surfaces in contract with cement, concrete, masonry, plaster or dissimilar metals with heavy coat of bituminous paint.

.12 Apply sealants at junction of metal flashings and dissimilar materials with continuous bead of sealant.

.13 Where flashing and/or counterflashing are to be installed in reglets, ensure reglet has been provided. Do not attempt to flash without reglet where reglet is required. Crimp edges of flashing which are to be inserted in reglets and turn min. 1 inch into joints. Provide backer rod and sealant as detailed.

.14 Provide underlay for sheet metal installed over masonry, concrete or wood. Lay underlay dry as sheet metal Work is installed. Secure in place and lap joints 4 inches.

.15 Imperfections in sheet metal Work such as holes, dents, creases, or oil-canning is cause for rejection.

.16 Repair damaged sheet metal Work, wash entire installation down, and leave in neat condition.

.17 Provide all flashing required for proper execution and completion of Work in acceptable manner.

3.5 INSTALLATION (for Galvanized Steel Flashing and Alum. Flashing)

.1 Provide metal flashings as per contract drawings.

.2 Insert flashing into to form tight fit. Secure in place with lead wedges and concealed fasteners. Seal flashings into reglets with sealant, make watertight.

.3 Protect all membrane flashings with metal counter flashings.

.4 Clean surfaces to be covered with metal flashings of dirt and other foreign matter. Drive projecting nails flush with substrate. Do not apply metal flashings over substrates likely to cause rupture.

.5 Provide underlay of resin sized paper under metal flashings installed over concrete, steel or wood. Lay underlay dry as sheet metal work is installed. Secure in place and lap joints 100 mm.

.6 Secure flashings to supporting building elements with concealed continuous cleats and locking strips; avoid exposed surface fasteners.

.7 Fill and seal seams with sealant; rivet corners.

.8 Where flashing is punctured by bolts, provide sheet lead or neoprene washers, 6 mm larger than bolt hole.

.9 Where vertical portion of metal flashing exceeds 300 mm provides vertical standing seams at 600 mm o.c.

.10 Imperfections in metal flashing work such as holes, dents, creases, or oil-canning will not be accepted.

.11 Seal metal joints watertight.

3.6 CLEANING AND PROTECTION

.1 Remove protective film (if any) from zinc panel surfaces promptly upon installation (or prior if film covers any concealed seam areas) with care to avoid damage to finish.

.2 Clean exposed metal surfaces of substances that would interfere with uniform oxidation and weathering and as recommended by panel manufacturer and maintain in a clean condition during construction. Use WD-40 applied to a clean cloth and apply light pressure to remove contaminated surface. Never apply cleaner directly to zinc surface.

.3 Ensure that cleaning by other trades working in proximity to zinc installation is in accordance with the recommendations of the zinc manufacturer.

.4 Damaged units: Replace panels and other components of the work that have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Gutters and downspouts.

.2 Precast concrete splash pads.

1.2 RELATED SECTIONS

.1 Section 07 14 00 – Fluid Applied Waterproofing.

.2 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing.

.3 Section 07 62 00 – Sheet Metal Flashing and Trim.

1.3 REFERENCES

.1 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 SMACNA - Architectural Sheet Metal Manual.

1.4 SUBMITTALS

.1 Section 01 33 00 - Submittal Procedures

.2 Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

.3 Product Data: Provide data on prefabricated components.

.4 Samples: Submit two (2) samples, 100 mm long illustrating component design, finish, colour, and configuration.

1.5 MOCK-UP

.1 Perform mock-ups if request by Consultant.

1.6 QUALITY ASSURANCE

.1 Conform to SMACNA Manual.

1.7 QUALIFICATIONS

.1 Fabricator and Installer:

.1 Same qualified fabricator and installer are responsible for Section 07 42 13 Standing Seam Zinc Wall Panels and Roofing, Section 07 62 00 Sheet Metal Flashing and Trim and Section 07 71 23 Gutter and Downspouts.

.2 Product Source: All zinc product to be supplied by same manufacturer and fabricator.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 63 00 – Product Requirements.

.2 Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

.3 Prevent contact with materials during storage which may cause discolouration, staining, or damage.

PART 2 Products

2.1 MANUFACTURERS

.1 RHEINZINK America, Inc.
Woburn, MA 01081
Tel: (781) – 729-0812

Regional Sales Manager: Richard Stickland. Tel: 647-292-0401

2.2 PRODUCT

.1 RHEINZINK Roof Drainage System.

2.3 MATERIALS

.1 Galvanized steel for gutter box only. All other components are in zinc.

.2 Zinc Alloy Sheet/Coils:

.1 ZinTitanium Zinc Alloy whose base is electrolytic high grade with a 99.995 % Zn degree of purity and alloying additives of 0.08% - 1.0% copper and 0.07% - .12% titanium, .001% - .015% aluminum in accordance with ASTM B69-16 (or latest edition) – Architectural Rolled Zinc - Type 1 and Type 2.

.2 Panel Thickness: 0.8mm (22 ga).

2.4 COMPONENTS & ACCESSORIES

.1 Gutters: Box-shaped style profile (galvanized steel)

.2 Plug-in Outlet: Box-shaped style profile.

.3 Downspouts: Round profile.

.4 Leaf Guard: Profile to suit gutter.

.5 Accessories: Profiled to suit gutters and downspouts.

.6 Splash Pads: Precast concrete type.

.7 Rain Collector with GARDENA Hose connector.

.8 Anchorages and Fasteners: Type recommended by Manufacturer.

.9 Soldering: Lead solder containing 50% tin and 50% lead in accordance with ASTM B32 – 08 (or latest edition) or lead-free solder

.10 Flux: Felder ZD-Pro or equal

2.5 FABRICATION

.1 Fabricate gutters to suit.

.2 Fabricate with required connection pieces.

.3 Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

.4 Hem exposed edges of metal.

.5 Fabricate gutter and downspout accessories; seal watertight.

2.6 FINISHES

.1 RHEINZINK prePATINA: Graphite-grey.

2.7 EXAMINATION

.1 Verify that surfaces are ready to receive work.

2.8 INSTALLATION

.1 Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

.2 Join lengths with formed seams sealed watertight. Flash and seal solder gutters to downspouts and accessories.

.3 Slope gutters to RWL.

.4 Seal metal joints watertight.

.5 Connect downspouts to RHEINZINK Rain Collector with GARDENA Hose connectors.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Tested and listed firestopping systems.

1.2 RELATED SECTIONS

.1 Section 05 12 00 - Structural Steel.

.2 Section 07 21 13 – Board Insulation.

.3 Section 07 21 29 – Sprayed Insulation.

.4 Section 07 26 00 – Air Barrier, Air/Vapour Retarders.

.5 Section 09 21 16 – Gypsum Board.

.6 Section 09 22 16 – Interior Non-Load Bearing Metal Stud Framing.

.7 Division 23 – Heating, Ventilation, and Air Conditioning (HVAC)

.8 Division 26 – Electrical

1.3 REFERENCES

.1 CAN/ULC-S101-07 - Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S102.2-10 - Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

.4 CAN/ULC-S115 - Standard Method of Fire Tests of Firestop Systems.

.5 ULC-FR-14 - Fire Resistance Directory (2014 Edition).

1.4 SYSTEM DESCRIPTION

.1 Tested and listed firestopping systems consisting of a material or materials, the wall or floor assembly, and penetrating items or gaps, assembled or placed in spaces, gaps, joints and building perimeters, to restore the fire resistance rating and or smoke resistant properties of a fire resistance rated assembly or smoke resistant assembly.

1.5 PERFORMANCE REQUIREMENTS

.1 Materials, accessories and application procedures listed by or tested to CAN/ULC-S115 to comply with applicable building code requirements.

.2 Firestopping Materials: CAN/ULC-S101, to achieve a fire rating as noted on Drawings.

.3 Surface Burning Characteristics: CAN/ULC-S102 or CAN/ULC-S102.2, as applicable.

.4 Smoke Resistance: For areas where smoke resistance is required, provide firestop systems with L-ratings of maximum 25.4l/sec/sq m opening area.

.5 Environmental Resistance: Systems to be resistant to environmental conditions they will be exposed to, as apparent at design stage.

1.6 COORDINATION

.1 Section 01 31 00 - Project Management and Coordination.

.2 Coordination: Coordinate with other work having a direct bearing on work of this section.

1.7 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 - Submitted Procedures.

.2 Product Data: Provide manufacturer's written data to show proposed material, rating and application of material for use in rated separation, reinforcement, anchorage, fastenings and method of installation, compliance with listed standards. Construction details should accurately reflect actual job conditions.

.3 System Design Listings: Submit system design listings including illustrations from a qualified nationally recognized testing and inspection agency applicable to each firestop configuration.

.4 Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) from firestop manufacturer where no specific third party tested, listed and classified firestop system is available for a particular firestop configuration.

.5 Installation Data: Manufacturer's written special preparation and installation requirements and tested and listed firestop systems designs.

.6 Contractor's Certificates:

.1 Provide FCIA Member in Good Standing letter or certificate for the current year, on FCIA letterhead.

.2 Current ULC Qualified Firestop Contractor Certificate and individual Designated Responsible Individual Certificate.

.7 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.8 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience and FCIA Manufacturer Member in good standing.

.3 Contractor Qualifications: Company specializing in performing the work of this section and as follows:

.1 FCIA Member in good standing.

.2 Minimum one (1) person employed at the firm who has passed the ULC Firestop Exam.

.3 ULC Qualified Firestop Contractor Program.

.4 FM approved in accordance with FM standard 4991 - Approval of Firestop Contractors.

.5 FCIA Member in good standing.

.6 Licensed by the province or local authority where applicable.

.7 Completed not less than five (5) comparable scale projects.

.4 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer. Obtain firestop systems for complete project, from a single primary firestop systems manufacturer, to the greatest extent possible.

1.9 MOCK-UP

.1 Section 01 45 00 - Quality Control.

.2 Provide mock-up of applied firestopping assemblies.

.3 Apply 1 sq m to a representative substrate surface.

.4 Apply firestop material to a representative penetrated stud wall and concrete substrate surface.

.5 Obtain Consultant's acceptance of mock-up before start of Work.

.6 Retain and maintain accepted mock-ups during construction in undisturbed condition as a standard for judging completed work.

.7 Locate where directed by Consultant.

.8 Approved mock-up may remain as part of the Work.

1.10 REGULATORY REQUIREMENTS

.1 Conform to applicable code for fire resistance ratings and surface burning characteristics.

.2 Provide certificate of compliance from authority having jurisdiction indicating approval of materials, tested and listed systems or engineering judgments used.

1.11 SITE CONDITIONS

.1 Install as per manufacturer’s written instructions.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Manufacturers:

.1 3M Fire Protection Products.

.2 BALCO, Inc.

.3 HILTI, Inc.

.4 Specified Technologies, Inc

.5 Thermal Ceramics, Inc.

.6 Thermafiber, Inc.

.2 Substitutions: Refer to Section 01 62 00 – Product Exchange Requirements.

2.2 MATERIALS

.1 Fire Stopping Systems and Materials: Tested and listed by ULC-FR, and conforming to construction type, penetrant type, annular space requirements and fire rating involved in each separate instance.

.1 Asbestos free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4 S115 and not to exceed opening sizes for which they are intended.

.2 Fire stop system rating for service penetrations: to suit Ontario Building Code.

.3 Fire stop system rating for sealing junction of rated walls to rated floors and ceilings: to suit Ontario Building Code

.2 Service penetration assemblies: certified by ULC in accordance with CAN4 S115.

.3 Service penetration fire stop components: certified by ULC in accordance with CAN4 S115.

.4 Fire resistance rating of installed fire stopping assembly not less than the fire resistance rating of surrounding floor and wall assembly, and in accordance with Ontario Building Code.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations.

2.3 ACCESSORIES

.1 Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

.2 Forming/Packing Material: Permanent type, suitable for application.

.3 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 - Examination and Preparation.

.2 Verify opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping are ready to receive the work of this section.

.3 Examine sizes and conditions of voids to be filled to establish correct thickness and installation of materials.

.4 Verify tested and listed systems selected are applicable to the conditions encountered.

.5 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Clean substrate surfaces as recommended in manufacturer's written instructions, of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material and performance of firestop system for fire or smoke resistant situations.

.2 Remove incompatible materials which may affect bond.

.3 Install damming or backing materials to arrest liquid material leakage.

.4 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.5 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 APPLICATION

.1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

.2 Apply primer and firestopping materials to manufacturer's written instructions.

.3 Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping to tested and listed system or engineering judgment to ensure continuity and integrity of fire separation are maintained.

.4 Apply firestopping material in sufficient thickness to achieve rating.

.5 Compress fibred material to achieve a density of 40% of its uncompressed density.

.6 Place intumescent coating in sufficient coats to achieve rating required.

.7 Dam Material: Remove dam material after firestopping material has cured.

.8 Tool or trowel exposed surfaces to a neat finish.

.9 Remove excess compound promptly as work progresses and upon completion

3.4 CLEANING

.1 Section 01 74 00 - Cleaning and Waste Processing.

.2 Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION OF FINISHED WORK

.1 Protect adjacent surfaces from damage by material installation.

3.6 SCHEDULES

.1 Fire stop and smoke seal at:

.1 Penetrations through fire resistance rated concrete, and gypsum board partitions and walls.

.2 Top of fire resistance rated concrete and gypsum board partitions.

.3 Intersection of fire resistance rated concrete and gypsum board partitions.

.4 Control and sway joints in fire resistance rated concrete and gypsum board partitions and walls.

.5 Penetrations through fire resistance rated floor slabs, ceilings and roofs.

.6 Openings and sleeves installed for future use through fire separations.

.7 Around mechanical and electrical assemblies penetrating fire separations

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Joint sealant work required to seal building tightly from exterior and interior, to withstand action of elements and to complete building envelope, air and vapour barriers, and all other joint sealant work, unless specified to be included under other Sections.

1.2 RELATED SECTIONS

.1 Section 07 13 00 – Sheet Membrane Waterproofing.

.2 Section 07 14 00 – Fluid Applied Waterproofing.

.3 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing.

.4 Section 07 62 00 – Sheet Metal Flashing and Trim.

.5 Section 07 71 23 – Gutters and Downspouts.

.6 Section 08 12 13 – Metal Doors and Frames.

.7 Section 08 44 13 – Glazed Aluminum Curtain Walls.

.8 Section 08 63 00 – Unit Skylights.

1.3 REFERENCES

.1 ASTM C834 – Specification for Latex Sealants.

.2 ASTM C920 – Specification for Elastomeric Joint Sealants.

.3 ASTM C1193 – Guide for Use of Joint Sealants.

.4 ASTM C1311 – Specification for Solvent Release Sealants.

.5 ASTM C1330 – Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

1.4 DEFINITIONS

.1 **Type "A" conditions:** All exposed joints on the exterior and interior of wall envelope and all joints throughout that are subject to movement. The principal locations are as follows:

- .1 Perimeter of exterior hollow metal frames and steel channel frames at junctions with adjacent construction.
- .2 Control joints in exterior concrete walls.
- .3 Joint between door seals and adjacent construction.
- .4 Other locations indicated on the Drawings

.2 **Type "B" conditions**: All joints on the building interior that are not subject to movement and that require filling for appearance or sanitary reasons. The principal locations are as follows:

.1 Joints between metal frames of all kinds and adjacent construction, in interior partitions.

.2 Inside corners in exposed locations; concrete to column junctures.

.3 Other locations indicated on the Drawings

.3 **Type "C" conditions:** Exposed areas on the building interior which require a mildew resistant sealant. The principal locations are as follows:

.1 Joints around washroom accessories, water closets, urinals, lavatories, vanities and shelves.

.2 Joints around counters at walls.

.3 Other locations indicated on the Drawings.

1.5 COORDINATION

.1 Section 01 31 00 – Project Managing and Coordination

.2 Coordination:

.1 Coordinate with other Work having a direct bearing on Work of this section.

.2 Coordinate the Work with all sections referencing this section.

1.6 SUBMITTALS FOR REVIEW

.1 Product Data: Submit product information from sealant manufacturer prior to commencement of work verifying the following:

.1 Selected sealant materials are those specified.

.2 Chemical characteristics, limitations; colour availability.

.3 Suitability of sealants for purposes intended and join design.

.4 Substrate preparation and application procedures. Indicate special procedures, surface preparation, perimeter conditions that require special attention.

.5 Documentation that product meets or exceeds specified requirements.

.6 Test report on adhesion, compatibility and staining effect on samples of materials used on Project;

.7 Sealants compatibility with other materials and products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumen, concrete, metals and metal finishes, ceramic tile, plastic laminates, paints;

.8 Suitability of sealants for temperature and humidity conditions at time of application.

.9 Shop Drawings: Indicate sealant joints and dimensions, location, materials, structural bite, glueline thickness, joint profile, and support framing.

.10 Samples: Submit two (2) samples, 6 inch in size illustrating sealant colour for selection.

1.7 QUALITY ASSURANCE

.1 Perform Work to sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

.2 Perform sealant application Work to ASTM C1481.

.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

.4 Applicator Qualifications: Company specializing in performing the Work of this section with minimum five (5) years documented experience and approved by the manufacturer.

1.8 MOCK-UP

.1 At Site, in areas designated by Consultant provide samples of each type of sealant application minimum 36" long each, showing location, size, shape and depth of joint complete with backup materials, primer, caulking and sealant, bond, colour and quality of installation work. Construct additional samples if required to obtain approval. Do no sealing work until samples have been approved. Approved samples shall become standard of comparison for sealing and caulking work on Site and shall become part of Work.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Section 01 61 00 – Product and Material Requirements.

.2 Accept materials on site in manufacturer’s unopened original packaging.

.3 Store primers and sealants in dry location with ambient temperature as per manufacturer’s written recommendation.

1.10 ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation

1.11 SCHEDULING

.1 Schedule work so waterproofing, water repellents and preservative finishes are installed after sealants, unless sealant manufacturer approves otherwise in writing.

.2 Ensure sealants are cured before covering with other materials.

1.12 WARRANTY

.1 Section 01 78 10 – Closeout Submittals

.2 Provide a five (25) year warranty against defects and deficiencies. Promptly correct to satisfaction of Consultant and at no expense to the owner, any defects or deficiencies which become apparent within the warranty period. Defects include, but are not limited to: cracking, crumbling, melting, shrinkage, sags, failure in adhesion, cohesion or reversion, air and moisture leakage, marbling or streaking due to improper mixing, discolouration due to dirt pick-up during curing, and staining of adjacent materials.

.3 Warranty: Include coverage for installed sealants and accessories which fail to achieve water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 Products

2.1 MANUFACTURERS

.1 Tremco, Inc., Commercial Sealants and Waterproofing Division
An RPM Company, Beachwood OH;
(866) 321-6357;
email: techresources@tremcoinc.com; www.tremcosealants.com.

.2 Dow Corning

.3 Substitutions: Refer to Section 01 62 00 – Product Exchange Requirements.

2.2 SEALANTS

.1 Sealant “Type A” Conditions: Multi-component, polyurethane, chemical curing, non-staining, non-bleeding, non-sagging type: colour to be selected from manufacturer’s standard colour range.

.1 Elongation Capability 25%.

.2 Service Temperature Range -40 to 82 degrees C.

.3 Shore A Hardness Range 20 to 35.

.4 Product:

.2 Sealant “Type B” Conditions: Non sag, one part in acrylic polymer caulk, chemical curing, non-staining, non-bleeding, non-sagging type: Colour to be selected from manufacturer’s standard colour range.

.1 Service Temperature Range: 5 to 60 degrees C.

.2 Shore A Hardness Range 50 to ± 5.

.3 Product: Mono 555 manufactured by Tremco

.3 Sealant “Type C” Conditions: Mildew resistant silicone sealant to ASTM C920, type S, Grade NS, class 25, and meeting requirements of FDA regulation 21 CFR 177.2600, Non-Staining, non-bleeding, non-sagging, type: colour to be selected from manufacturer’s standard colour range:

.1 Service Temperature Range: -37 to 60 degrees C.

.2 Shore A Hardness Range: 25.

.3 Product: 786 Mildew Resistant Silicone Sealant Manufactured by Dow Corning.

2.3 ACCESSORIES

.1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.

.2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

.3 Joint Backing: ASTM C1330, round, closed cell; polyethylene foam rod, oversized 30% to 50% larger than joint width.

.4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

.5 Masking tape: Non-staining, non-absorbent type compatible with sealant and adjacent surfaces.

.6 Setting Blocks and Spacers: Compatible with silicone sealant and recommended by sealant manufacturer.

PART 3 Execution

PART 4 Execution

4.1 EXAMINATION

.1 Verify that joint openings and substrate surfaces are clean, dry, and free of frost and ready to receive Work.

.2 Verify that joint backing and release tapes are compatible with sealant.

4.2 PREPARATION

.1 Remove loose materials and foreign matter which might impair adhesion of sealant.

.2 Clean and prime joints to sealant manufacturer's written instructions.

.3 Perform preparation to ASTM C1193 for solvent release and latex base sealants.

.4 Perform preparation to manufacturer's written instructions.

.5 Protect elements surrounding the Work of this section from damage or disfiguration.

4.3 INSTALLATION

.1 Perform installation in accordance with ASTM C1193.

.2 Install sealant to sealant manufacturer's written instructions.

.3 Measure joint dimensions and size materials to achieve 2:1 width/depth ratios. Minimum joint size shall be 6mm x 6mm, maximum depth 13mm.

.4 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.

.5 Install bond breaker where joint backing is not used.

.6 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

.7 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

.8 Tool joints concave unless otherwise detailed.

.9 Where installation is visible at mortar joints, flashing reglets, etc, dress sealant with sharp sand while still tacky.

4.4 FIELD QUALITY CONTROL

.1 Section 01 45 00 – Quality Control.

.2 Joint Sealants: Perform adhesion tests to manufacturer's written instructions and ASTM C1193, Field-Applied Sealant Joint Hand Pull Tab.

.1 Perform test seven (7) days after installation at a rate of one test every 1000 ft of installed sealant.

.3 Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.

.4 Maintain test log and submit report to Consultant indicating tests, locations, dates, results, and remedial actions.

4.5 CLEANING

.1 Section 01 74 00 – Cleaning and Waste Processing.

.2 Immediately clean adjacent surfaces which have been soiled and leave Work in neat, clean condition. Remove excess materials, compound smears or other soling resulting from application of sealants. Use recommended cleaners and solvents.

4.6 PROTECTION OF FINISHED WORK

.1 Remove masking tape and excess sealant.

.2 Protect sealants until cured.

4.7 SCHEDULE

.1 Window perimeter: To match window frames.

.2 Flashing: To match flashing.

.3 At Flashing Reglets: To match.

.4 Door Perimeter: To match door frames.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Non-rated, fire rated, and thermally insulated metal doors and frames.

1.2 RELATED SECTIONS

.1 Section 08 71 00 - Door Hardware.

.2 Section 09 90 10 - Paint and Coatings.

1.3 REFERENCES

.1 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM E2074 - Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.

.3 CAN4-S104M, Standard Method for Fire Test of Door Assemblies

.4 CAN4-S105M, Standard Specification for Fire Door Frames, Meeting the Performance Required by CAN4-S104M.

.5 CSDFMA (Canadian Steel Door and Frame Manufacturers Association).

.6 DHI (Door Hardware Institute) - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

.7 NFPA 80 - Fire Doors, Fire Windows.

.8 NFPA 252 - Fire Tests for Door Assemblies.

.9 SDI-100 - Standard Steel Doors and Frames.

.10 UL 10B - Fire Tests of Door Assemblies.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 - Submittal Procedures.

.2 Product Data: Indicate door configurations, location of cut-outs for hardware reinforcement.

.3 Shop drawings:

.1 Submit shop drawings for each type of door and frame indicating:

.1 Thickness and type of steel.

.2 Thickness and type of core.

.3 Thickness and type of steel stiffeners and location of them within the door.

.4 Thickness and type of metal facing on edges of door and method of fastening.

.5 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings, and arrangement for hardware.

.6 Door and frame elevations.

.2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule. Indicate doors and frames to be fire rated.

.4 Samples: Submit two (2) samples of door face metal.

1.5 QUALITY ASSURANCE

.1 Perform Work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.

.2 Label and list fire rated doors and frames by an organization acceptable to authorities having jurisdiction and accredited by the Standards Council of Canada in conformance with CAN4-S104M and CAN4-S105M for ratings indicated, Labelling shall be in accordance with NFPA 80.

1.6 DELIVERY, STORAGE, AND PROTECTION

.1 Protect doors with resilient packaging sealed with heat shrunk plastic.

.2 Accept doors on site in manufacturer's packaging. Inspect for damage.

.3 Break seal on site to permit ventilation.

PART 2 Products

2.1 MANUFACTURERS

.1 Baron Metal Industries Inc.

.2 Daybar Industries Limited.

.3 Fleming Steel Doors and Frames.

.4 Substitutions: Refer to Section 01 62 00 - Product Exchange Procedures.

2.2 MATERIALS

.1 Steel: ASTM A568/A568M, Class 1; Commercial grade steel, hot dip galvanized to ASTM A653/A653M, ZF075 satin coat finish.

.2 Minimum base steel thickness:

.1	Frames	1.6 mm
.2	Typical doors	1.6 mm.
.3	Interior stiffeners	0.9 mm

.4	Lock/strike reinforcements	1.6 mm
.5	Hinge reinforcements	2.7 mm.
.6	All other reinforcement	1.6 mm
.7	Top and bottom channels	1.2 mm
.8	Glazing stops	0.9 mm
.9	Guard boxes	0.9 mm
.10	Jamb spreaders	0.9 mm

.3 Top caps and thermal breaks: CGSB 41-GP-19Ma; Rigid PVC extrusions.

.4 Primer: CAN/CGSB 1.198

.5 Core material:

.1 Interior and fire rated doors: Mineral fibre insulation to CAN/ULC S702, Type1A; 24 kg/m3.

.2 Exterior doors: Rigid poly/isocyanuate, closed cell insulation, 32 kg/m3,thermal value: RSI 1.9.

.6 Screws: Stainless steel screws with countersunk flat head.

.7 Door silencers: Type 6-180, black neoprene.

.8 Frame anchors:

.1 Frames in masonry: 1.2 mm minimum, adjustable T-strap jamb anchors.

.2 Labelled frames: In accordance with ULC requirements.

.9 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.

.10 Labels for fire doors and door frame: Brass plate, riveted to door and door frame.

2.3 FABRICATION

.1 General

.1 Fabricate doors and frames in accordance with reviewed shop drawings.

.2 Welding: CSA W59-M to produce a finished unit with no visible seams or joints, square, true and free of distortion.

.3 Welding: Continuous unless specified otherwise. Execute welding by a firm fully acceptable to the Canadian Welding Bureau to requirements of CSA W47.1.

.4 Form profiles accurately to details shown on Contract Drawings.

.5 Ream and remove burrs from drilled and punched holes.

.6 Grind welded corners and joints to a flat plane and fill with metallic filler and sand to a uniform smooth finish. Apply one coat of primer.

.2 Frames:

.1 Fabricate frames of welded construction. Cut mitres and joints accurately and weld continuously on inside of frame profile. Exterior frames to be thermally broken.

.2 Construct large frame sections with provision for on Site assembly to suit Site conditions.

.3 Blank, reinforce, drill and tap frames for mortised, templated hardware. Protect mortised cut-outs with guard boxes.

.4 Reinforce frames where required for surface mounted hardware.

.5 Reinforce frames over 1200 mm wide with roll formed steel channels fitted tightly into frame head, flush with top.

.6 Furnish exterior door frames with a continuously welded integral steel weather drip at head of frame.

.7 Prepare each door opening for single stud rubber door silencers, 3 for single door openings located in strike jamb, and 2 for double door openings located in head.

.8 Install 2 channel or angle spreaders per frame, to ensure correct frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting in place.

.3 Anchorage:

.1 Anchor units to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb, minimum number of anchors for each jamb:

.1 Frames up to 2285 mm 3 anchors.

.2 Frames from 2285 mm to 2440 mm 4 anchors.

.2 Where frames are to be set in masonry or concrete, supply adjustable anchors to trade installing frame.

.3 Fabricate frames for installation in steel stud partitions with steel anchors of suitable design, minimum number of anchors for each jamb :

.1 Frames up to 2285 mm height 4 anchors.

.2 Frames 2285 mm to 2440 mm 5 anchors.

.4 General Door Requirements

.1 Hollow steel construction, flush swing type, of sizes to conform to details, schedules and reviewed shop drawings with provisions for cut-outs and reinforced to receive hardware fastenings.

.2 Blank, reinforce, drill and tap doors for mortised, templated hardware. Where required, reinforce doors for surface mounted hardware and door closers.

.3 Reinforce oversized doors with steel channels and plates.

.4 Bevel both stiles of single doors 1 in 16.

.5 Reinforce doors with galvanized metal stiffeners at 150 mm o.c

.5 Interior Doors

.1 Supply and install inverted, recessed, fully welded channels at top and bottom of doors.

.2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked with tack welded for

entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.

.3 Fill hollow space within door and vertical stiffeners from top to bottom with mineral fibre batt insulation.

.6 Fire Rated Doors

.1 Supply and install inverted, recessed, spot welded channels at top and bottom of doors. Supply and install steel flush top caps on exterior doors

.2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints continuously welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.

.3 Fabricate doors to achieve fire rating as indicated on drawings and in accordance with ULC. Provide ULC label on door at hinged edge midway between top hinge and head of door.

2.4 FINISH

.1 Steel Sheet: Galvanized to ASTM A653/A653M.

.2 Primer: Baked.

.3 Factory Finish: Baked enamel of colour noted on drawings.

PART 3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

.1 Install hollow metal frames, windows, and screens plumb, square, level, secure, and at correct elevation.

.2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation. Install door silencers.

.3 Secure anchorages and connections to adjacent construction. Brace frames rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Supply and install vertical supports as indicated on drawings for openings over 1200 mm in width. Remove wood spreaders after frames have been built-in.

.4 Allow for structural deflection and prevent structural loads from being transmitted to hollow metal frames.

.5 Touch-up areas where galvanized coating has been removed or damaged with primer.

.6 Install fire rated doors and frames in accordance with requirements of NFPA 80.

3.3 ADJUSTING

.1 Adjust doors for smooth and balanced door movement.

.2 Clean doors, frames and screens

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Work to be completed by **Heritage Woodworker. Heritage Woodworker** is responsible to undertake the following:

.1 Section 06 03 10 - Finish Carpentry Restoration and Replication.

.2 Section 08 20 00 – Wood Doors and Frames.

.3 Preparation of new wood doors to receive glazing and door hardware.

.4 Section 09 03 98 - Restoration Painting and Coating.

.5 New wood stairs to Pit.

.6 Restoration of existing door hardware for Door 101E1, 101E2, and 101 E3 as indicated on drawings.

.7 Modification of existing window hardware as indicated on drawings.

.8 Modification of existing door hardware as indicated on drawings.

1.2 RELATED SECTIONS

.1 Section 06 03 10 – Finish Carpentry Restoration & Replication

.2 Section 08 80 50 – Glazing.

.3 Section 08 71 00 - Door Hardware.

.4 Section 09 03 98 – Restoration Paint and Coatings.

1.3 REFERENCES

.1 AWMAC (Architectural Woodwork Manufacturers Association of Canada) - Quality Standards.

.2 HPMA HP - Hardwood and Decorative Plywood.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 - Submittal Procedures.

.2 Product Data: Submit manufacturer's Product data indicating stile and rail core materials and construction, veneer species, type and characteristics.

.3 Manufacturer's installation instructions: Indicate Special Installation instructions.

.4 Shop drawings:

.1 Submit shop drawings for each type of door and frame indicating: door opening criteria, elevations, sizes, types, swings, undercuts if required, special blocking for hardware, factory finishing criteria, identify cut-outs for glazing and rating if required.

.2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule. Indicate doors and frames to be fire rated.

.5 Submit one (1) sample of each door construction, size to suit, to illustrate the door construction, rail and stile construction, slab door construction, detail at glazing, final finish for both a rated and non-rated paneled door.

.6 Submit mock-ups of factory finish on typical door and frame for both painted and stained/transparent finishes.

1.5 MOCK-UP

.1 Provide mock-up if requested by Consultant.

1.6 QUALITY ASSURANCE

.1 Perform work in accordance with AWMAC Quality Standard, Premium Grade. Maintain one copy on site.

.2 Finish doors in accordance with AWMAC Quality Standard, Premium Grade.

.3 Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum five (5) years documented experience. Submit proof of qualifications of company to Consultant prior to starting work.

1.7 DELIVERY, STORAGE, AND PROTECTION

.1 Accept doors on site in manufacturer's packaging. Inspect for damage.

1.8 PROJECT CONDITIONS

.1 Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period

1.9 WARRANTY

.1 Special Warranty: Manufacturer’s standard form, signed by manufacturer, installer and contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, and have warped (bow, cup or twist) more than ¼” (6.4mm) in a 42-by-84 inch (1067-by-2134 mm) section.

.1 Warranty shall be in effect during the following period of time from date of Substantial Completion:

.1 Interior Doors: Five years.

.2 Exterior Doors: Five years.

PART 2 Products

2.1 MANUFACTURERS

.1 Manufacturer must be able to provide custom sized doors, frames as noted on drawings.

2.2 MATERIALS

.1 Provide doors made with adhesives that do not contain urea-formaldehyde resins. Adhesive type to suit door location.

.2 Manufacturer's standard for 45mm (1 ¾") thick doors.

.3 Grade of Doors for Stained/transparent Finish: Premium.

.4 Grade of Doors for Paint Finish: Custom.

.5 Wood Species for Stained/transparent Finish: Oak.

.6 Wood Species for Paint Finish: Manufacturer's standard mill option species and cut for stiles and rails; with panels of same species or wood-based composite materials.

.7 Size, Layout and Thickness: As shown on Drawings.

2.3 FABRICATION

.1 Fabricate doors in accordance with AWI/AWMAC Quality Standards requirements.

.2 Fabricate wood doors in sizes indicated for Project site fitting.

.3 Factory fit doors to suit frame-opening sizes indicated and site verified. Comply with clearance requirements of referenced quality standard for fitting. Comply with clearance requirements for fire-rated doors.

.4 Factory machine doors for hardware that is not surface applied.

.5 Glazed Openings: Glaze doors and screens at factory with glass of type and thickness indicated, complying with requirements in Sections 08 80 50 Glazing. Glaze doors using solid wood mouldings for non-fire-rated and 20 minute fire-rated. For 45, 60 and 90 minute fire-rated doors, glaze using primed metal for paint finish or as required to achieve required rating.

.6 Glazed Openings: Trim openings indicated for glazing with solid wood mouldings (non fire-rated and 20 minute fire-rated), with one side removable. For 45, 60 and 90-minute fire-rated glazed openings, provide primed metal for painted finish for all glazed openings

2.4 FINISHING:

.1 Finish wood doors in accordance with AWI/ AWMAC Quality Standard for both painted and stained/transparent finish. Field touch-ups as required.

.2 Finish: As indicated on drawings.

.3 Finish doors in accordance with approved mock-up samples.

PART 3 Execution

3.1 EXAMINATION

.1 Verify that opening sizes and tolerances are acceptable.

.2 Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

.1 Install wood frames plumb, square, level, secure, and at correct elevation.

.2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation.

.3 Install doors in accordance with AWI/AWMAC Quality Standards requirements for fit, clearance and joinery tolerances.

.4 Trim door width by cutting equally on both jamb edges. Trim door height by cutting bottom edges to a maximum of 16mm.

.5 Machine prep for hardware. Coordinate with Section 08 71 00 – Door Hardware.

.6 Install fire rated doors and frames in accordance with ULC fire resistance rating requirements.

.7 Touch-up areas where factory finish coating has been removed or damaged.

3.3 ADJUSTING AND CLEANING

.1 Adjust doors for smooth and balanced door movement. Adjust closures for full closure

.2 Clean doors, frames and screens.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Thermally broken, stick-built glazed aluminum curtain wall, skylight, doors, windows and accessories.

.2 Preparation of aluminum doors for door hardware.

1.2 RELATED SECTIONS

.1 Section 05 12 00 – Structural Steel

.2 Section 05 40 00 – Cold Form Metal Framing

.3 Section 07 26 00 – Air Barrier, Air/Vapour Retarders

.4 Section 07 62 00 – Sheet Metal Flashing and Trim

.5 Section 07 92 00 – Joint Sealants

.6 Section 08 70 00 – Finish Hardware

.7 Section 08 80 50 – Glazing

.8 Division 28 – Electrical.

1.3 REFERENCES

.1 Aluminum Association (AA) - DAF 45 2003, Designation System For Aluminum Finishes.

.2 AAMA-501-2005, Methods of Test for Exterior Walls.

.3 AAMA-2603-2013, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

.4 AAMA-2604-2013, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

.5 AAMA-2605-2013, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

.6 AAMA CW DG-1-96, Aluminum Curtain Wall Design Guide Manual.

.7 AAMA CW-10-2012, Care and Handling of Architectural Aluminum From Shop to Site.

.8 AAMA CW-11-1985, Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing.

.9 AAMA-TIR A1-2004, Sound Control for Fenestration Products.

.10 ASTM A653 / A653M – 09], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.11 ASTM B209-2010, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.12 ASTM B221-2013, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.13 ASTM C612 – 2014, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.14 ASTM E283 2012, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.15 ASTM E331 2009, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.

.16 ASTM E413 – 04, Classification for Rating Sound Insulation.

.17 ASTM E1105 – 2008, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

.18 ASTM D2240 – 2010, Standard Test Method for Rubber Property—Durometer Hardness.

.19 CAN/CGSB-12.8-97, Insulating Glass Units.

.20 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

.21 CAN/CGSB-19.13-M87, Sealing Compound, One-Component, Elastomeric, Chemical Curing.

.22 CAN/CSA-S157 2005, Strength Design in Aluminum.

.23 CAN/CSA-S136–2007, North American Specification for the Design of Cold-Formed Steel Structural Members.

.24 CAN/CSA W59.2 M1991(R2003), Welded Aluminum Construction.

.25 CCD 45 1995, Sealants and Caulking Compounds.

.26 CAN/ULC-S710.1 2005, Standard for Thermal Insulation – Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials Standard for Thermal Insulation - Bead - Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials.

1.4 SYSTEM DESCRIPTION

.1 Thermally broken, vertical stick-built glazed aluminum curtain wall and skylight system of tubular aluminum sections with self supported framing, shop fabricated, factory prefinished, vision glass, related flashings and anchorage and attachment devices.

.2 Ensure assembled system design permits re-glazing of individual glass and from exterior without requiring removal of structural mullions.

1.5 PERFORMANCE REQUIREMENTS

.1 Design curtain wall to AAMA CW-DG-1.

.1 Design glazed aluminum system following rainscreen principles.

.2 Ensure horizontal members are sealed to vertical members to form individual compartments in accordance with rainscreen principles.

.3 Ventilate and pressure equalize air space outside exterior surface of insulation to exterior.

.2 Design aluminum systemin accordance with following Climatic Design Data for Trotono contained in the Ontario Building Code:

.1 Design temperature: January 1%, July 2 1/2"%.

.2 Hourly winde pressure: 1 in 50 year occurrence.

.3 Design to prevent accumulation of condensation on interior side of aluminum system framing under the following service conditions:

.1 Interior temperature: 22.5°C

.2 Exterior temperature: -22.7°C.

.3 Interior RH: 35%.

.4 Design aluminum components to CAN/CSA S157.

.5 Design and size aluminum system components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of wall using design pressure of 0.95 kPa (20 psf) to AAMA CW 11.

.1 Design for expansion and contraction caused by cycling temperature range of 95 degrees C over 12 hour period without causing detrimental effect to system components.

.2 Thermal expansion: Ensure aluminum system can withstand temperature differential of 85 degrees C and is able to accommodate interior and exterior system expansion and contraction without damage to components or deterioration of seals.

.3 Design vertical expansion joints with baffled overlaps and compressed resilient air seal laid between mullion ends.

.4 Ensure aluminum system is designed to accommodate:

.1 Movement within curtain wall assembly.

.2 Movement between system and perimeter framing components.

.3 Dynamic loading and release of loads.

.4 Deflection of structural support framing.

.5 Creep of concrete structural members.

.6 Limit mullion deflection to flexure limit of glass L/175 maximum with full recovery of glazing materials.

.7 Deadload prevention: Design curtain wall system with separate, integrated support for insulating glass units.

.8 Sound attenuation through wall system (exterior to interior): STC 33 ASTM E413.

.9 Glass dimensions: Size glass units to CAN/CGSB-12.20.

.10 Flatness criteria: 6 mm (0.25 inches) maximum in 6 m (20 feet) for each panel.

.11 Air infiltration:

.1 Curtain wall and operable unit assemblies: 0.3 L/s/m2 (0.63 cfm) maximum of wall area to ASTM E283 at differential pressure across assembly of 300 Pa (0.044 psi).

.2 Sloped glazing/skylights: 0.3 L/s/m2 (0.63 cfm) at differential of 500 Pa.

.12 Water infiltration: None to ASTM E331 differential pressure across assembly of 720 Pa (0.104 psi).

.13 Ensure interior surfaces have no condensation before exposed edges of sealed units reach dew point temperatures during testing to AAMA 501.

.14 Maintain continuous air barrier and vapour retarder throughout building envelope and aluminum work assembly. Prevent accumulation or storage of water within aluminum work. Prevent water from entering interior when tested in accordance with ASTM E331.

.15 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.

.16 Provide all reinforcing within aluminum members as required by design and OBC to provide structurally sound assembly.

.17 Design aluminum system and connections to substrate where the bottom of the aluminum work extends to a point below 42” above finished floor level and separates a floor level from an adjacent interconnected space to withstand the

required guard and handrail loads in accordance with the OBC and applicable local regulations. Provide a letter signed and sealed by a Professional Engineer certifying that the aluminum work conforms to the OBC requirements.

1.6 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures

.2 Product Data: Submit product data including manufacturer's literature for glazed aluminum curtain wall extruded members, panels, components and accessories, indicating compliance with specified requirements and material characteristics.

.1 Submit list on curtain wall manufacturer's letterhead of materials, components and accessories to be incorporated into Work.

.2 Include product names, types and series numbers.

.3 Include contact information for manufacturer and their representative for this Project.

.3 Shop Drawings: Submit drawings stamped and signed by Professional Engineer registered or licensed in the Province of Ontario. Include on shop drawings:

.1 Curtain wall panel and component dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required. Indicate location of manufacturer's nameplates.

.2 Show size and location of seismic restraints. Include seismic design calculations.

.3 Include details of fasteners between interior and exterior extrusions ensuring no penetratrion of thermal break or thermal bridging.

.4 Samples:

.1 Submit duplicate 300 x 300 mm sample sections showing prefinished aluminum surface, finish, colour and texture, and including section of infill panel.

.2 Submit duplicate 300 x 300 mm sample sections of insulating glass unit showing glazing materials and edge and corner details.

.5 Test Reports:

.1 Submit test reports showing compliance with specified performance characteristics and physical properties including air infiltration, water infiltration and structural performance.

.6 Field Reports: Submit manufacturer's field reports within 3 days of manufacturer representatives site visit and inspection.

.7 Operation and Maintenance Data: Supply maintenance data for curtain wall for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.7 QUALITY ASSURANCE

.1 Perform Work in accordance with AAMA - Aluminum Curtain Wall Design Guide Manual.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years experience.

.3 Installer Qualifications: Company specializing in performing the work of this section five (5) years documented and similar experience, approved by manufacturer.

.4 Retain a Professional Engineer, licensed in Province of Ontario, with experience in aluminum work to perform the following services as part of the Work:

.1 Design of aluminum work.

.2 Review, Stamp and sign shop drawings.

.3 Conduit on-Site inspections and prepare and submit inspection reports.

1.8 MOCK-UP

.1 Construct mock-ups location TBD.

.2 Provide one (1) unit mock-up including intermediate mullion, vision glass. Assemble to illustrate component assembly including glazing materials, drainage, attachments, anchors, flashing, threshold and sealant.

.3 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.

.4 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

.5 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

1.9 DELIVERY, STORAGE, AND PROTECTION

.1 Delivery and Acceptance Requirements:

.1 Deliver material in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver glazed aluminum curtain wall materials and components in manufacturer’s original packaging with identification labels intact and in sizes to suit project.

.2 Material Handling: To AAMA CW-10.

.3 Storage and Handling Requirements: Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

.1 Material storage: To AAMA CW-10.

.4 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.

.5 Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling.

1.10 COORDINATION

.1 Co-ordination: Co-ordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.

.2 Pre-installation Meeting: Convene pre-installation meeting after Award of Contract and two weeks prior to commencing work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer=s written installation instructions.

.3 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Consultant;

.3 Glazing subcontractor;

.4 Manufacturer’s Technical Representative.

.4 Ensure meeting agenda includes review of methods and procedures related to glazed aluminum curtain wall installation including co-ordination with related work.

.5 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting.

1.11 WARRANTY

.1 Manufacturer’s warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.

.2 Warranty period: 2 years commencing on Date of Substantial Performance of Work.

.3 Work in general: Five year warranty against defects and failure of system, and to remain completely weathertight and air and water leakproof within the tolerances and limits specified.

.4 Insulating units: Ten year warranty against breakage due to faulty workmanship or materials, loss of air seal and condensation.

.5 Laminated finish: Five year warranty against peeling, checking, blistering or cracking, and be nonconvertible; fading shall be within ±5 NBS. (National Bureau of Standards, reflectance value for fading)

PART 2 Products

2.1 MANUFACTURERS

.1 Basis of Design Product:

.1 Kawneer Company, Inc.

.1 Curtain Wall: 1600 Wall System ®1

.1 Sight line: 2-1/2".

.2 Outside-glazed pressure plate format.

.3 System Depth: 6" and 10 1/2" depth with 1" insulating glazing unit.

.2 Window: GLASSvent® Windows – Project-out Casement.

.3 Door: AA®250 Thermal Entrance.

.2 Construction Specialties, Inc.:

.1 4" Storm Resistant Fixed Horizontal louver with blank off.

2.2 MATERIALS

.1 Curtain Wall System and Components:

.1 Extruded aluminum: To ASTM B221, 6063 alloy with T6 temper.

.2 Sheet aluminum: To ASTM B209, utility grade for unexposed surfaces.

.3 Air barrier liner: Reinforce panels to maintain flat surface.

.1 Concealed locations: 0.952 mm (20 gauge) steel sheet with 458 g/m2 (1.25 oz/sq.ft) galvanized coating and corners sealed at concealed locations.

.2 Interior exposed locations: 1.588 mm (16 gauge) clear anodized aluminum sheet.

.4 Fasteners, screws and bolts: Tamperproof, cadmium plated stainless steel 400 series to meet curtain wall requirements and as recommended by manufacturer.

.5 Anchors: Ensure anchors have three-way adjustment. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

.1 Pressure Plate:

.1 Pressure plate shall be aluminum.

.2 Pressure plate shall be fastened to the mullion with stainless steel screws.

.7 Insulating glass units: As specified in Section 08 80 00 - Glazing.

.8 Thermal Break: Glass fibre reinforced polyamide porthole extrusion that provides minimum ¼" separation.

.9 Reinforcing Members:

.3 Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.

.4 Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

.10 Sealant:

.1 For sealants required within fabricated curtain wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

.11 Accessories:

.5 Gasketing: Silicone compatible rubber or extruded silicone gaskets.

.6 Setting Blocks: 85 +/- 5 neoprene, Shore A Durometer hardness.

.7 Spacers: 55 +/- silicone, Shore A Durometer hardness.

.8 Sealant: One part silicone neutral cure low modulus sealant, GE Silicones "Silpruf SCS 2000" or equivalent by Dow Corning. Colour as selected by the Consultant from standard colour selection.

.9 Flashings: 3 mm (0.125 inches) thick aluminum flashing to profiles indicated [and in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.

.10 Liquid Foam Insulation: Single component, moisture cure, low expansion rate spray-in-place polyurethane liquid foam insulation to ULC-S710.1 and in accordance with manufacturer's written recommendations.

.11 Miscellaneous Components: Covers, copings, special flashings, filler pieces, termination pieces, cap closures, expansion joint covers, and metal bellows to match curtain wall system as indicated.

2.3 CURTAIN WALL FRAMING

.1 Framing Members:

.1 Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads

.2 Glazing System: Four-sided captured

.3 Glazing Plane: Front

.2 Glass: Insulated glazing unit. Refer to Section 08 80 50 - Glazing.

.3 Brackets and Reinforcements:

.1 Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

.4 Framing Sealants:

.1 Shall be suitable for glazed aluminum curtain wall as recommended by sealant manufacturer

.5 Fasteners and Accessories:

.1 Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.

.2 Where exposed, fasteners and accessories shall be stainless steel.

.6 Perimeter Anchors:

.1 When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

2.4 OPERABLE UNITS

.1 Window System:

.1 Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" (2.3) wall thickness at any location for the main frame and sash members.

.2 Thermal Barrier: The thermal barrier shall be Kawneer consisting of low conductive polymer full depth of infill.

.3 Fasteners: Nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

.4 Anchors: Nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

.5 Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

.6 Glass and Glazing Materials: Refer to Division 08 Section “Glazing” for glass units and glazing requirements applicable for four sided structural silicone glazed aluminum window units.

.7 Glazing System: Glazing method shall be four sided structural silicone glazed in accordance with manufacturer’s standards

.8 Hardware:

.1 General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.

.2 Project-Out / Outswing Casement Windows: Provide the following operating hardware:

.1 Stainless Steel 4-Bar Hinges.

.2 Access control and handle to be determined by Owner from standard selection.

.3 All hardware to match curtain wall frame finish.

.9 Accessories:

.1 Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

.2 Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

.3 Sealants and joint fillers for joints at perimeter of window system as specified in Division 7 Section “Joint Sealants”.

.4 Insect Screens: Extruded aluminum frames, 6063-T6 alloy and temper, joined at corners: 18 x 16 mesh fiberglass screen cloth; frames finished to match aluminum curtain wall; splines shall be extruded vinyl, removable to permit rescreening.

.2 Doors:

.1 Aluminum Extrusions:

.1 Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish.

.2 Not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.

.2 Fasteners:

.1 Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

.3 Anchors, Clips and Accessories:

.1 Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.

.2 Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

.4 Reinforcing Members:

.1 Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.

.2 Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

.5 Weather-Stripping and Weather Seals:

.1 Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.

.2 Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material.

.3 Comply with AAMA 701/702.

.6 Finishing hardware: Refer to Section 08 71 00 - Door Hardware.

2.5 FABRICATION

.1 Do aluminum welding to CAN/CSA W59.2.

.2 Fabricate aluminum assemblies of extruded sections to sizes and profiles indicated.

.1 Ensure vertical and horizontal members are tubular extrusions designed for shear block corner construction.

.2 Structural silicone joints where indicated.

.3 Ensure caps for mullion assemblies are constructed without gap.

.3 Construct units square, plumb and free from distortion, waves, twists, buckles or other defects detrimental to performance or appearance.

.1 Ensure curtain wall is fabricated with separate, integrated support for insulating glass unit.

.2 Do glazing in accordance with Section 08 80 00 – Glazing.

.3 Site glazing is permitted.

.4 Window Vent and/or Vent Frame Joinery: Mitered and Mechanically clipped and/or staked. Factory sealed vent and /or vent frame and corner joints.

.5 Fabricate curtain wall with minimum clearances and shim spacing around panel perimeter and ensure installation and dynamic movement of perimeter seal is enabled.

.6 Accurately fit and secure joints and corners.

.1 Ensure joints are flush, hairline, and weatherproof.

.7 Prepare curtain wall to receive anchor devices.

.8 Use only concealed fasteners

.1 Ensure fasteners do not penetrate thermal break.

.2 Where fasteners cannot be concealed, countersunk screws finished to match adjacent material may be used upon receipt of written approval from Consultant.

.9 Prepare components to receive doors and openings as indicated.

.10 Reinforce head rail of interior components to receive track brackets and attachments as indicated.

.11 Reinforce framing members for exterior imposed loads where required.

.12 Visible manufacturer's labels are not permitted.

2.6 FINISHES

.1 Powder Coated (High Performance Polyster):

.1 Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

.2 Factory Finishing: Kawneer Permacoat™ AAMA 2604, Powder Coating (Color to be determined.)

PART 3 Execution

3.1 EXAMINATION

.1 Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for curtain wall installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

.1 Install curtain wall, skylight, doors, louvers and windows in accordance with manufacturer's written instructions.

.2 Do aluminum welding to CAN/CSA W59.2.

.3 Attach aluminum system assemblies to structure plumb and level, free from warp, and allow for sufficient adjustment to accommodate construction tolerances and other irregularities.

.1 Maintain dimensional tolerances and align with adjacent work.

.2 Use alignment attachments and shims to permanently fasten elements to building structure.

.3 Clean welded surfaces and apply protective primer to field welds and adjacent surfaces.

.4 Install thermal isolation where components penetrate or disrupt building insulation.

.5 Install sill flashings.

.6 Co-ordinate attachment and seal of perimeter air barrier and vapour barriers in accordance with Section 07 26 00.

.7 Install liquid foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

.8 Install insulating glass units in accordance with Section 08 80 00 - Glazing and to manufacturer's written instructions.

.9 Install perimeter sealant to method required to achieve performance criteria, backing materials, and installation criteria in accordance with Section 07 92 00 - Joint Sealants.

3.3 FIELD QUALITY CONTROL

.1 Coordinate field inspection in accordance with Section 01 45 00 - Quality Control.

.2 Site Installation Tolerances:

.1 Variation from plumb: 12 mm per 30 m maximum.

.2 Misalignment of two adjacent panels or members: 0.8 mm maximum.

.3 Sealant space between curtain wall and adjacent construction: 13 mm maximum.

.3 Manufacturer's Services:

.1 Coordinate manufacturer's services with Section 01 45 00 - Quality Control.

.2 Submit to Consultant a written agreement from the manufacturer to perform the manufacturer's services.

.3 Schedule manufacturer's review of work procedures at stages listed:

.1 Product Application: 1 off site review.

.2 Fabrication and Handling: 1 review at authorized installers fabrication facilities.

.3 Installation: 3 site reviews at commencement of Work, 50% completion of Work and upon completion of Work.

.4 Submit manufacturer's written reports to Consultant describing:

.1 The scope of work requested.

.2 Date, time and location.

.3 Procedures performed.

.4 Observed or detected non-compliances or inconsistencies with manufacturers' recommended instructions.

.5 Limitations or disclaimers regarding the procedures performed.

.6 Conduct Air Infiltration Test in accordance with ASTM E783.

.7 Conduit Water Infiltration Test in accordance with ASTM E 1105.

.8 Obtain reports within seven days of review and submit immediately to Consultant.

3.4 CLEANING

.1 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.1 Leave work area clean end of each day.

.2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.

3.5 PROTECTION OF FINISHED WORK

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by glazed aluminum curtain wall installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Hardware for existing and new doors.

.2 Cost to supply Hardware to be included within Section 01 21 00 Cash Allowances. Installation to be included in Contract Price.

1.2 RELATED SECTIONS

.1 Section 06 03 10 – Finish Carpentry Restoration & Replication.

.2 Section 08 12 13 - Metal Doors and Frames

.3 Section 08 20 00 - Wood Doors and Frames

.4 Section 08 44 13 - Glazed Aluminum Curtain Walls and Skylight Systems

.5 Division 26 – Electrical

1.3 REFERENCES

.1 CAN/ULC-S104-10 - Standard Method for Fire Tests of Door Assemblies.

.2 CAN/ULC-S132-07 - Standard for Emergency Exit and Emergency Fire Exit Hardware.

.3 CSDMA (Canadian Steel Door Manufacturers Association).

.4 DHI (Door and Hardware Institute Canada) - AHC and EHC certification programs.

.5 DHI (Door Hardware Institute) - A115 series.

.6 DHI - Recommended Locations for Architectural Hardware for Flush Wood Doors (1993).

.7 BHMA (Builders Hardware Manufacturers Association) - A156 Series Standards.

.8 NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2013 Edition.

.9 NFPA 252 - Fire Tests of Door Assemblies, 2012 Edition.

.10 UL 10B-2008 - Fire Tests of Door Assemblies (10th Edition).

.11 UL 305-2012 - Standard for Panic Hardware (6th Edition).

1.4 PRICE AND PAYMENT PROCEDURES

.1 Allowances: Section 01 21 00 – Cash allowances affecting this section.

1.5 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures

.2 Prior to starting work of this Section, retain Upper Canada Speciality Hardware as Architectural Hardware Consultant. Contact Don Roberton donr@ucsh.com.

.3 In conjunction with Consultant, Architectural Hardware Consultant to develop Hardware Schedule and provide detailed Product data for review.

.4 Product data: Submit manufacturer's Product data indicating catalogue cuts, finishes, hardware specifications, compliance with reference standards, transportation, storage, handling, installation requirements and coordination with new and existing doors and frames.

.5 Upon completion of Hardware Schedule provide Shop Drawings to Consultant for review. Ensure that prior to submitting shop drawings to Consultant that hardware has been coordinated with door and frame shop drawings. Both submittal packages to occur at the same time.

.6 Shop drawings:

.1 Submit shop drawings and complete hardware list indicating:

.1 Door locations, sizes, hardware manufacturer’s catalogue numbers, finish symbols and quantities required.

.2 Locations and mounting heights of each type of hardware.

.2 Coordinate and supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cut-outs and reinforcement for hardware.

.3 Submit templates to required trade to arrange for provisions for accurate setting and fitting of hardware.

.7 Samples:

.1 Submit 1 sample of each item from hardware specified and include manufacturer’s parts lists and installation instructions.

.2 Submit hardware component samples illustrating style, colour and finish. Tag, number, finish, building location, date and catalogue number.

.3 Do not order hardware until samples have been accepted. Submit new samples to replace rejected samples. Supply hardware and finishes identical to each accepted sample.

.8 Keying Schedule: In conjunction with Consultant and Owner, Architectural Hardware Consultant to develop Hardware Schedule and provide detailed Product data for review.

1.6 CLOSEOUT SUBMITTALS

.1 Section 01 78 10 – Closeout Submittals

.2 Operation and Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance and safety precautions.

.3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

.4 Record Documentation:

.1 Record actual locations of installed cylinders and their master key code.

.2 Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

.5 Parts list with name and address of supplier.

1.7 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Provide ten (10) extra key lock cylinders for each [master] keyed group.

.2 Tools:

.1 Provide special wrenches and tools applicable to each different or special hardware component.

.2 Provide maintenance tools and accessories supplied by hardware component manufacturer.

1.8 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Perform Work to the following requirements:

.1 BHMA

.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience and registered with BHMA.

.4 Hardware supplier: Company specializing in supplying commercial door hardware and acceptable to manufacturer.

.5 Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to prepare the Hardware Schedule, specification and keying schedule. Architectural Hardware Consultant to inspect completed installation and certify that hardware has been supplied and installed in accordance with manufacturer's printed instructions and as specified.

.6 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.9 COORDINATION

.1 Coordinate with other work having a direct bearing on work of this section.

.1 Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.

.2 Coordinate Owner's keying requirements during the course of the Work.

.2 Sequencing: Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.10 REGULATORY REQUIREMENTS

.1 Conform to applicable code for Products requiring electrical connection. Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

.2 Submit manufacturer's certificate that finish hardware and fire rated hardware meets specified requirements.

1.11 DELIVERY, STORAGE, AND PROTECTION

.1 Be responsible for packaging of hardware, on a set by set basis. As material is received from various manufacturers identify it to correspond to Hardware List symbols.

.2 Label packages legibly, indicating manufacturer's number, types, sizes, opening number and Hardware List reference number. Wrap hardware and include in package, screws, bolts and fastening necessary for correct installation. If hardware package is not complete, pay additional charges incurred by installer.

.3 Deliver hardware to Site packaged, labelled and cross-referenced to hardware list for each item and its' scheduled installation location.

.4 Accept Products of this Section on Site and that each item is undamaged.

.5 Catalogue and store hardware in secure area.

1.12 WARRANTY

.1 Section 01 78 10 - Warranties.

.2 Provide five (5) year manufacturer warranty for door closers.

Part 2 Products

2.1 GENERAL

.1 Carefully check and verify Hardware List against Hardware Schedule and Drawings to ensure that hardware listed can be used as specified. Inform Consultant of concerns regarding quality, quantity, operation or function of hardware selected:

.1 Verify hand of doors, examine details on Contract Drawings and at Site to ensure hardware supplied can be correctly installed and is correct for Work as constructed.

.2 Select hardware in accordance with applicable codes and regulations and to approval of local Fire Marshall.

.3 Replace and pay for defective hardware including hardware which was incorrectly selected, and remedial and installation costs.

.2 Ensure that hardware selected will function correctly, meets Contract requirements and Ontario Building Code and authorities having jurisdiction.

.3 Ensure that each hardware item is of same type, design and by same manufacturer.

.4 Manufacturer's names or trademarks are not permitted on exposed surfaces of hardware.

.5 Include in packing slip a list of parts, name of supplier and door number in which lock is to be installed.

.6 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.

.7 Fire Rated Assemblies:

.1 Hardware: Selected and installed in accordance with applicable codes and regulations, NFPA-80 and to approval of Ontario Fire Marshall.

.2 Fire rated doors: ULC labelled hardware. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.

.3 Lock sets and latch sets on fire rated doors: 19 mm throw minimum.

2.2 ACCESSORIES

.1 Items to be attached to existing and new walls with expandable shields, lag screws, bolts or other fastening devices as required. Exposed screws: Stainless steel, Phillips or Robertson heads.

2.3 FINISHES

.1 Free from defects, clean, unstained and of a uniform colour for each type of finish required.

.2 Colour: As noted on Finish Schedule

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation

.2 Verify that doors and frames are ready to receive work and dimensions are as indicated on Shop Drawings.

.3 Verify that electric power is available to power operated devices and is of the correct characteristics.

3.2 INSTALLATION

.1 Install hardware in accordance with manufacturer's installation instructions and applicable codes and regulations.

.2 Install hardware in accordance with hardware templates.

.3 Adjust fixed and operable hardware for correct clearances and function.

.4 Mount hardware measured from finished floor to centre of hardware, unless indicated otherwise:

.1 Top hinge: 250 mm from head of door to top.

.2 Bottom hinge: 265 mm from finished floor to bottom of hinge.

.3 Intermediate hinge: Equal distance between top and bottom hinge.

.4 Locksets, latch sets: 1000 mm.

.5 Panic device crossbar: 1000 mm.

.6 Push plates: 1000 mm to centre line plates.

.7 Guard bars: 1100 mm.

.8 Door pulls: 1105 mm to centre line of pulls.

.9 Blank strike: 1450 mm.

.10 Blank fronts: 1450 mm

3.3 FIELD QUALITY CONTROL

.1 Have hardware inspected after installation by Architectural Hardware Consultant, obtain certification in writing that hardware has been supplied and installed in accordance with Specifications and hardware manufacturer's instructions and is functioning correctly.

3.4 ADJUSTING

.1 Adjust hardware for smooth operation.

3.5 PROTECTION OF FINISHED WORK

.1 Do not permit adjacent work to damage hardware or finish.

3.6 HARDWARE GROUPS

.1 Hardware Groups and keying to be developed in conjunction with Architectural Hardware Consultant and Consultant/Owner.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Design, labour, Products, equipment, tools and services necessary for glazing and glazing Work in accordance with Contract Documents.

1.2 RELATED SECTIONS

.1 Section 07 26 00 – Air Barrier, Air/Vapour Retarders

.2 Section 07 42 13 – Standing Seam Zinc Wall Panels and Roofing.

.3 Section 07 62 00 – Sheet Metal Flashing and Trim

.4 Section 08 44 13 – Glazed Aluminum Curtain Walls and Skylight System.

1.3 REFERENCES

.1 ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Glazing Materials Used in Buildings.

.2 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM E330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

.4 ASTM E546 - Test Method For Frost Point of Sealed Insulating Glass Units.

.5 ASTM E773 - Test Method for Accelerated Weathering of Sealed Insulating Glass Units.

.6 ASTM E774 - Classification of the Durability of Sealed Insulating Glass Units.

.7 ASTM E2010-01: Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.

.8 IGMAC (Insulating Glass Manufacturers Association of Canada) - Sealed Insulating Glass: Glass to Elastomer Edge, Glass to Mastic Edge, Special Glasses.

.9 CAN/CGSB-12.20M, Structural Design of Glass for Buildings.

.10 Underwriters Laboratories, Inc. (UL):

.1 UL9 – Fire Tests of Window Assemblies.

.2 UL 10B – Fire Tests of Door Assemblies.

.3 UL 10C – Positive Pressure Fire Tests of Door Assemblies.

.11 Standard Council of Canada:

.1 CAN/ULC-S101 Standard Test of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S104 Standard Method of Fire Tests of Door Assemblies.

.3 CAN/JLC- S106 Standard Method of Fire Tests of Window and Glass Block Assemblies.

1.4 PERFORMANCE REQUIREMENTS

.1 Design glass to CAN/CGSB-12.20-M. Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.

.2 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.

.3 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.4 Perform a thermal stress analysis on each insulating unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.

.5 Fire-rated glass ceramic laminated clear and wireless glazing material lised for use in impact safety-rated locations such as doors, transoms and borrowed lites with fire rating requirements ranging from 20 to 180 minutes with required hose stream test.

.6 Passes positive pressure test standards UL-10C.

1.5 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures

.2 Product Data on Glass: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

.3 Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colours.

.4 Shop drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures for fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

.5 Samples

.1 Submit one sample of each type of glass.

.2 300 x 300 mm of each type of insulating glass unit.

.6 Certificates

.1 Submit manufacturer's certification that glass and glazing materials are compatible.

.7 IGMA Compliance Audit

.1 Submit in accordance with Section 01 33 00, a written certification of successful completion of a Compliance Audit within the last six months.

1.6 QUALITY ASSURANCE

.1 Insulating glass unit fabricators shall be a certified member of the Insulating Glass Manufacturer's Alliance (IGMA). IGMA members must participate in the certification program and shall have successfully passed a Compliance Audit within the last six months.

.2 Fire Protective Rated Glass: Each lite shall bear permanent, non-removalbe label of UL certifying it for use in teste and rated fire protective assemblies.

.3 Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per UL10B, classified and labeled by UL.

1.7 MOCK-UP

.1 Construct mock-ups of the following items:

.1 Full height Glazing unit. Location TBD.

.2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.

.3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

.4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4°C, and when positive that no moisture is accumulating on them from rain, mist, or condensation.

.2 When temperature of glazing surfaces is below 4°C, obtain from Consultant approval of glazing methods and protective measures which will be used during glazing operations.

1.9 WARRANTY

.1 Section 01 78 36 - Warranties

.2 Provide a ten (10) year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 Products

2.1 ACCEPTABLE GLASS MANUFACTURER'S

.1 AGC Glass Unlimited

.2 Vitro Architectural Product

.3 Viracon Inc.

.4 Bravura Architectural Products

.5 Technical Glass Products.

.6 Walker Glass Company Ltd.

2.2 MATERIALS

.1 All materials under Work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits.

.2 Float glass (FGL): 1/4" (6 mm) thick, conforming to CAN/CGSB 12.3 M, glazing quality (Standard float glass and Ultra clear Low Iron float glass), polished.

.3 Heat strengthened glass (HSGL); CAN/CGSB-12.3-M; clear float glass, glazing quality, heat strengthened in accordance with ASTM C1048, King HS, minimum 10 mm thick unless indicated otherwise.

.4 Tempered glass (TGL): CAN/CGSB-12.1-M, Type2, Class B, Category II, clear, minimum 1/4" (6 mm) thick.

.5 Laminated glass (LGL):

.1 Laminated glass (LGL1): to CAN/CGSB-12.1, Category II, consisting of top layer of 1/8" (3 mm) thick clear float glass, 0.8mm thick clear PVB interlayer, and bottom layer of 1/8" (3 mm) thick clear float glass. Heat strengthening and/or tempered laminated glass as necessary to prevent thermal breakage. For use at skylights.

.2 Laminated glass (LGL2): to CAN/CGSB-12.1, Category II, consisting of top layer of 3/8" (10 mm) thick clear heat strengthened glass (HSGL) (low iron tempered Sevasa anti-slip texture (final texture TBD), 1.5mm thick clear PVB interlayer, one layer of 10mm thick clear heat strengthen glass (HSGL), 1.5mm thick clear PVB interlayer and one layer of 3/8" (10mm) thick clear heat for a minimum thickness of 33mm. For use at glass floor.

.6 Ceramic frit glass (CFGL): 6mm thick unless otherwise indicated. Bird friendly glass with acid-etched visual vertical markers. AviProtek® E Pattern 211 by Walker Glass Company Ltd.

.7 Fire Rated Glass (FGL):

.1 FireLite Plus® manufactured by Nippon Electric Glass Company, Ltd and distrubted by Technical Glass Products.

.2 Thickness: 3/4" (19 mm) overall

.3 Fire Rating: 45 minutes fire resistant.

.4 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).

.5 Surface Finish: Standard Garde.

.6 Positive Pressure Test: JL 10C; passes.

.7 Labeling: Permanently label each piece of FireLite Plus® with the FireLite Plus® logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the FireLite Plus® label only for sizes that exceed the listing.

.8 Plastic film: Style as selected by Consultant and manufactured by 3M. Application pattern as indicated on drawings. Provide translucent film for locations where privacy is required.

.9 Insulated glass units: To CAN/CGSB-12.8-M and IGMA requirements utilizing approved non-metallic PVC or Fibreglass edges spacer in black. Dual seal with a PIB primary seal and silicone secondary seal.

.10 Argon gas: 100% pure. Argon gas to be used to fill air space at all insulated glass unit.

.11 Low-E coating: High performance sputtered low-E coating. Provide insulating glass units with low-E coating edge deletion and low-E coating. Apply low-E coating to third surface unless otherwise indicated. “Solarban 60’ clear by Vitro. or approved alternatives.

.12 Insulated Glazing Unit types (IGU):

.1 IGU 1: Clear TGL inside, argon filled air space, CFGL outside with acid etched coating on 1st face. Low-E coating to be applied on 2nd face of glass pane in insulating glass unit. 1” overall thickness.

Performance value as follow:

.1 Visible light transmittance: 72%

.2 U-Values: Winter nighttime - 0.24

.3 Shading coefficient: 0.44

.4 Solar heat gain coefficient: 0.39

.2 IGU 3: Clear LGL1 inside, argon filled space,, CFGL outside with acide etched coating on 1st face. Low-E coating to be applied on 2nd face of glass pane in insulating glass unit. 1” overall thickness. For use at overhead glazing. 1” overall thickness.

.13 Glazing and rebate primers, sealants, sealers, and cleaners: compatible with each other. Type as recommended by glass manufacturer.

.14 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating lass unit secondary sealant.

.15 Glazing Sealant (Structural Glazing):

.1 Silicone, One part in accordance with ASTM C920, Type S or M, Grade NS, Class 25.

.2 Structural glazing tensile bead: “

2.3 GLAZING COMPOUNDS

.1 Manufacturers:

.1 GE Canada

.2 DOW Corning

.3 Tremco Canada

.4 Substitutions: Refer to Section 01 62 00 – Product Exchange Requirements

.2 Glazing compound: 1 part clear silicone. GE Canada "Silpruf SCS 2000", Dow Corning "795" or Tremco "Spectrum 2".

2.4 GLAZING ACCESSORIES

.1 Spacer shims and setting blocks: Neoprene, Shore "A" Durometer hardness 70 90, 100 mm long, wide enough to extend from fixed stop to opposite face of glass and of height suitable to provide adequate glazing "bite" for setting blocks. Neoprene, Shore "A" 40 to 50 Durometer hardness, of adequate thickness to provide correct glass to face clearance of at least 3 mm for spacer shims. For glass in fire rated doors (screens) use ULC approved fire resistant setting blocks and spacer shims.

.2 Glazing tape: 440 polyisobutylene-butyl tape by Tremco Ltd.

2.5 GLAZING COMPOUND AND ACCESSORIES FOR FIRE-RATED GLAZING MATERIALS

.1 Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.

.2 Glazing Compound: DAP 33 putty.

.3 Silicone Sealant: Dow Corning 795 – Dow Corning Corp.

.4 Setting Blocks: Neoprene, EPDM.

.5 Cleaners, Primers and Sealers: Type recommended by manufacturer of glass and gaskets.

PART 3 Execution

3.1 EXAMINATION

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

.4 Install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION - EXTERIOR GLAZING

.1 Apply setting blocks at quarter points on all four sides of openings.

.2 Cut glazing tape to proper length and set against permanent stops approximately 0.8 mm below sightline. Install horizontal strips first, extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbling with sealant.

.3 Remove backing paper from tape prior to setting glass.

.4 Apply continuous heel bead between glass and sash.

.5 Place glass in opening, press tightly and evenly against glazing tape.

.6 Apply continuous glazing tape on removable stop. Place and screw stop in place with fluorocarbon coated oval head screws. Apply elastomeric sealant cap bead over top between glass and removable stop.

3.4 IDENTIFICATION OF GLAZING

.1 Provide on one side of all glass lites, temporary, easily removable, large safety decals, immediately after glass installation. Maintain safety markings until final clean-up. Remove all markings at time of final clean-up.

3.5 FIELD QUALITY CONTROL

.1 Inspection will monitor quality of glazing.

3.6 MANUFACTURER'S FIELD SERVICES

.1 Glass and glazing product manufacturers to provide field surveillance of the installation of their Products.

.2 Monitor and report installation procedures and unacceptable conditions.

3.7 CLEANING

.1 Remove glazing materials from finish surfaces.

.2 Remove labels after Work is complete.

.3 Clean glass and adjacent surfaces.

3.8 PROTECTION OF FINISHED WORK

.1 After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Scope of work for the original Garage:

.1 Work to be completed by **Heritage Woodworker. Heritage Woodworker** is responsible to undertake the following:

.1 Section 06 03 10 - Finish Carpentry Restoration and Replication.

.2 Section 08 20 00 – Wood Doors and Frames.

.3 Preparation of new wood doors to receive glazing and door hardware.

.4 Section 09 03 98 - Restoration Painting and Coating.

.5 New wood stairs to Pit.

.6 Restoration of existing door hardware for Door 101E1, 101E2, and 101 E3 as indicated on drawings.

.7 Modification of existing window hardware as indicated on drawings.

.8 Modification of existing door hardware as indicated on drawings.

.2 Remove loose paint on the existing painted wood elements by scrapping and sanding. Prepare surface to receive new finishes.

.3 Repainting shall be by brush applied only. Spray or roller coating of the paint not permitted on any visible or finished faces and edges/side of the heritage windows and woodwork.

.4 Refer to drawings for area of work.

.2 Scope of work for new construction:

.1 Refer to Section 09 91 00 Paint and Coating.

.2 Refer to drawings for area of work.

1.2 SECTION INCLUDES

.1 Lightly sand/scrap any loose paint to a solid base.

.2 Cleaning of existing paints and coatings.

.3 Surface preparation.

.4 Application of new paints and coatings on existing and recreated wood elements generally in-situ and shop priming and painting of recreated window sashes and doors.

1.3 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 06 03 10 – Finish Carpentry Restoration and Replication.

.3 Section 08 20 00 – Wood Doors and Frames

1.4 REFERENCES

.1 ASTM D4442-07 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

.2 NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.

.3 MPI (Master Painters Institute) – Architectural Painting Specifications Manual and Maintenance Repainting Manual.

.4 SSPC (The Society for Protective Coatings) (formerly SSPC - Steel Structures Painting Council) - Steel Structures Painting Manual.

1.5 DEFINITIONS

.1 Crazing: Fine, jagged, interconnected breaks in top layer or layers of paint.

.2 Intercoat Peeling: Loss of adhesion between layers of paint.

.3 Peeling: Loss of adhesion of paint from substrate.

.4 Alligatoring: Crazing extending to substrate.

.5 Abrasive Methods: Paint removal by mechanical or manual methods using putty knifes, scrapers, wire brushes, sandpaper, sanding blocks, or sanding sponges.

.6 Thermal Methods: Paint removal by softening and raising the paint by applying heat via heat plate or gun, followed by scraping.

.7 Chemical Methods: Paint removal by softening the paint by applying chemical stripper, followed by scraping.

.8 Conform to ASTM D16 for interpretation of terms used in this Section.

1.6 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 – Submittal Procedures.

.2 Work of **Heritage Woodworker** to include site inventory and photo documentation of existing woodwork for original Garage.

.1 **Method Statement:** Include one comprehensive Method Statement for the entire scope of work of **Heritage Woodworker** (Section 06 03 10 Finish Carpentry Restoration & Replication and 08 20 00 Wood Doors and Frames outlining as a minimum all methods, procedures, materials and understanding of the work utilizing good conservation practices.

.2 **Qualifications:** Individuals assigned by the Heritage Woodworker to perform work of this Section must have minimum 10 years proven experience in working on similar type projects and working on heritage buildings under the review of recognized heritage consultants (members of CAHP or similar). Individuals not meeting these requirement may be removed from the project. If requested submit qualification documentation to Consultant prior to starting work.

.3 **Product Data and MSDS Sheets**: Provide manufacturer's data on materials proposed for use. Include:

.1 Product designation and grade of each paint type.

.2 Surface preparation materials and procedures.

.3 Product analysis and performance characteristics for each paint type.

.4 **Samples:** Submit two (2) samples, 75mm x 150mm in size illustrating each colour and luster, on representative substrate. Step each coat back so that all coats remain exposed.

.5 **Paint and Finish Schedule**: Detailed schedule indicating type and location of surface, preparation and priming requirements, paint products/materials and number of coats to be applied.

1.7 MOCK-UPS

.1 Restore finish type and color.

.2 Demonstrate surface preparation, primer, intermediate coats, and top coats.

.3 Locate where directed by Consultant.

.4 Approved mock-up may remain as part of the Work unless noted otherwise.

1.8 CLOSEOUT SUBMITTALS

.1 Section 01 78 10 – Closeout Submittals: Submission procedures.

1.9 REGULATORY REQUIREMENTS

.1 Conform to applicable code for flame and smoke rating requirements for finishes.

1.10 DELIVERY, STORAGE, AND PROTECTION

.1 Section 01 61 00 – Product Requirements: Transport, handle, store, and protect products.

.2 Deliver Products to site in sealed and labeled containers; inspect to verify acceptability.

.3 Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, colour designation, and instructions for mixing and reducing.

.4 Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

.5 Store paint materials at ambient temperature from 9 to 32 degrees Celsius in ventilated area, or as required by manufacturer's instructions.

1.11 ENVIRONMENTAL REQUIREMENTS

.1 Ambient Conditions:

.1 Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint Product manufacturer.

.2 Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint Product manufacturer.

.3 Minimum application temperatures for latex paints: 7 degrees Celsius for interiors; 10 degrees Celsius for exterior; unless required otherwise by manufacturer's instructions.

.4 Minimum application temperatures for stain: 10 to 30 degree Celsius. 21 degree Celsius is recommended.

.2 Provide lighting level of 80 foot candles measured mid-height at substrate surface.

.3 Humidity: Maximum 50% unless required otherwise by manufacturer's instructions.

1.12 EXTRA MATERIALS

.1 Section 01 78 10 – Closeout Submittals.

.2 Provide 1 gallon of each colour, type, and surface texture/finish to Owner.

.3 Label each container with colour, type, texture/finish, and locations, in addition to the manufacturer's label.

Part 2 Products

2.1 MATERIALS

.1 Paint:

.1 Primer: Fresh Start High Hiding All Purposes Primer. Product Code: K046. Manufactured by Benjamin Moore.

.2 Paint (exterior): AURA Waterborne Exterior Paint Low Lustre Finish. Product Code: K634. Manufactured by Benjamin Moore.

.3 Paint (interior): AURA Waterborne Interior Paint. Refer to sheen schedule on drawing. Manufactured by Benjamin Moore.

2.2 ACCESSORIES

.1 Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials required to achieve specified finishes; commercial quality.

.2 Patching materials: Latex filler.

.3 Fastener head cover materials: Latex filler.

.4 Sealer: SI sealer by West System

2.3 MIXES

.1 Uniformly mix paints to thoroughly disperse pigments prior to applying.

.2 Do not thin paint in excess of manufacturer's recommendations.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation: Verify existing conditions before starting Work.

.2 Verify that surfaces are ready to receive Work.

3.2 PREPARATION - GENERAL

.1 Measure moisture content of surfaces using electronic moisture meter. Do not apply coatings unless moisture content of surfaces are below following maximums:

.1 Wood: 15%, measured to ASTM D4442.

.2 Protect adjacent and underlying surfaces.

.3 Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

.4 Correct defects and clean surfaces capable of affecting Work of this Section.

.5 Seal marks that may bleed through surface finishes with shellac.

3.3 SURFACE PREPARATION

.1 General surface preparation for the original Garage:

.1 Wash surfaces with mild solution of household detergent and gallon clean water, applied with medium soft fibre brush. Rinse with clean water and allow to dry completely.

.2 Crazing and intercoat peeling: Remove affected loosen paint layers by gentle abrasive methods.

.3 Peeling and alligatoring: Remove all paint layers by gentle abrasive methods.

.4 Fill holes and indentations with filler appropriate to surface. Allow to dry; sand flush with adjacent surfaces.

.5 All surface shall be lightly sand to remove any sheen of existing paint.

.6 Sand surfaces smooth where paint is removed to expose substrate.

.7 Prevent damage to existing surfaces.

.8 Backprime exterior woodwork (new).

.9 Wood surfaces to be clean and dry with a moisture content of less than 12%.

.2 Substrate moisture tests:

.1 Test for moisture content over entire surface to be painted, minimum one test 2m² in field areas and one test/600 mm along inside corners including soffit to wall juncture.

.2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before paint system application. Install temporary drying fans if necessary.

.3 Re-test employing same criteria.

3.4 CLEANING EXISTING PAINTS

.1 Wash surfaces with mild solution of household detergent and clean water, applied with medium soft fibre brush.

.2 Rinse with clean water and allow to dry completely.

3.5 PAINT APPLICATION

.1 Apply painting systems in accordance with the MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.

.2 Do not apply finishes to surfaces that are not dry.

.3 Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

.4 Apply coatings to uniform appearance without laps, sags, curtains, holidays, and brush marks.

.5 Allow applied coats to dry before next coat is applied.

.6 Sand between coats on wood surfaces.

.7 Match final coat to approved color samples.

.8 Where clear finishes are specified, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

.9 Prime concealed surfaces of exterior wood in contact with masonry or cementitious materials with one (1) coat primer paint.

.10 Do not paint:

.1 Surfaces indicated on Drawings or specified to be unpainted or unfinished.

.2 Surfaces with factory applied finish coat or integral finish.

.3 Architectural metals including brass, bronze, and copper.

.4 Name tags or identifying markings.

3.6 STAIN APPLICATION

.1 Brush applied all finishes.

.2 Apply all coatings in accordance with manufacturer's recommendations. Paying special attention to curing times between coats.

3.7 ADJUSTING

.1 Touch up abraded, stained, and otherwise disfigured surfaces or refinish as required.

3.8 PAINT SCHEDULE

.1 All surfaces to receive one coat of Primer, 2 costs of Paint. Refer to finish schedule for colour and sheen.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Gypsum board and joint treatment.

.2 Gypsum sheathing.

1.2 RELATED SECTIONS

.1 Section 05 40 00 – Cold Formed Metal Framing.

.2 Section 06 10 00 – Rough Carpentry

.3 Section 07 21 13 – Board Insulation.

.4 Section 07 21 19 – Foamed in Place Insulation.

.5 Section 07 26 00 – Air Barrier, Air/Vapour Retarders.

.6 Section 09 91 10 – Paint and Coatings.

1.3 REFERENCES

.1 ASTM C36/C36M - Gypsum Wallboard.

.2 ASTM C79/C79M - Treated Core and Non-Treated Core for Gypsum Sheathing Board.

.3 ASTM C442/C442M - Gypsum Backing Board, Gypsum, Coreboard, and Gypsum Shaftliner Board.

.4 ASTM C475 - Joint Compound and Joint Tape for Finishing Gypsum Board.

.5 ASTM C630/C630M - Water-Resistant Gypsum Backing Board.

.6 ASTM C645 - Specifications for Non-Structural Steel Framing Members.

.7 ASTM C665 - Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.8 ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.

.9 ASTM C840 - Application and Finishing of Gypsum Board.

.10 ASTM C931 - Exterior Gypsum Soffit Board.

.11 ASTM C1002 - Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.12 ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions and Elements.

.13 ASTM E119 - Method for Fire Tests of Building Construction and Materials.

.14 GA 201 (Gypsum Association) - Gypsum Board for Walls and Ceilings.

.15 GA 214 (Gypsum Association) - Recommended Specification: Levels of Gypsum Board Finish.

.16 GA 216 (Gypsum Association) - Application of Gypsum Board.

.17 GA 600 (Gypsum Association) - Fire Resistance Design Manual.

.18 UL - Fire Resistance Directory.

.19 ITS (Intertek Testing Services) - Certification Listings.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 - Submittal Procedures.

.2 Submit manufacturer's product data indicating:

.1 Performance criteria, compliance with appropriate reference standard, characteristics and limitations;

.2 Product transportation, storage, handling and installation; and Requirements;

.3 WHMIS Material Safety Data Sheets.

.3 Submit written certification stating that structural system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

.4 Shop Drawings: Indicate special details associated with fireproofing, and acoustic seals.

1.5 QUALITY ASSURANCE

.1 Provide a list of the proposed drywall foreman and drywallers and their respective resumes a minimum one week prior to commencement of the work and include for each person their experience and list of related projects.

.2 Work of this Section to be completed by skilled, qualified and experienced workers trained in the installation of the Work of this Section.

1.6 SITE CONDITIONS

.1 Do not begin Work of this Section until:

.1 Structural, Mechanical and Electrical Work above the ceiling is complete.

.2 Firestopping, smoke seals and any required repairs to fire separations which will be hidden by the gypsum board is complete and reviewed.

.3 Substrate and ambient temperature is above 15°C.

.4 Relative humidity is below 80 %.

.5 Ventilation is adequate to remove excess moisture.

.2 Install temporary protection and facilities to maintain product manufacturer's and above specification, environmental requirements 24 hours before, during, and 24 hours after installation.

1.7 REGULATORY REQUIREMENTS

.1 Conform to applicable code for fire rated assemblies.

PART 2 Products

2.1 GENERAL

.1 All materials under Work of this Section, including but not limited to, sealants, adhesives, and primers are to have low VOC content limits.

.2 Wherever possible, gypsum board, steel studs, ceilings and framing used in work of this Section are to contain recycled content.

.3 Refer to Section 05 40 00 – Cold Formed Metal Framing.

.4 Refer to Section 09 22 16 – Interior Non-Load Bearing Metal Stud Framing

2.2 FRAMING MATERIALS

.1 Studs and Tracks: As specified in Refer to Section 05 40 00 – Cold Formed Metal Framing and Section 09 22 16 – Interior Non-Load Bearing Metal Stud Framing.

.2 Furring, Framing, and Accessories: ASTM C645, GA-216 and GA-600

.3 Fasteners: ASTM C1002, Type S, GA-216, corrosion resistant.

.4 Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

.5 Adhesive: GA-216.

2.3 GYPSUM BOARD MATERIALS

.1 Standard Gypsum Board: ASTM C36 1/2" and 5/8” thick, maximum length to minimized end joints unless indicated otherwise. CertainTeed Gypsum Canada, CGC Inc. or G-P Products.

.2 Fire Rated Gypsum Board: ASTM C36, fire resistive Type X, UL rated 15.9mm (5/8") thick, Sheetrock Firecode C Core Gypsum Panels, maximum length to minimize end joints unless indicated otherwise. Certainteed Gypsum Canada, CGC Inc. or G-P Products.

.3 Fire Rated Gypsum Board: ASTM D3273, fire resistive, moisture resistant and non-combustible gypsum core with coated glass mat facing. 15.9mm (5/8") thick, Densarmor Plus Fireguard by G-P Products.

.4 Mold and Moisture Resistant Gypsum Board: ASTM C1658, Type X and glass mat water-resistant gypsum panel. USG Sheetrock Brand Glass-Mat Panels Mold Tought ® AR Firecode® X.

.5 Shaft Wall and Ceiling Gypsum Board: ASTM C36, fire resistive Type X, UL rated 15.9mm (5/8") thick , Sheetrock Firecode C Core Gypsum Panels and 25.4 MM (1) CGC SheetRock Brand Glass-Mat Liner Panels. Maximum length to minimize end joints unless indicated otherwise. CGC Inc. .

.6 Exterior Gypsum Sheathing: ASTM C79; moisture resisitant and fire resistant (as noted on drawings) type; 5/6" thick, DensGlass, maximum length to minimize end joints unless indicated otherwise. Certainteed Gypsum Canada, CGC Inc. or G-P Products.

.7 Moisture Resistant Exterior Roof Sheathing: ASTM C630; moisture resistant, 5/8" thick, Dens Deck Roof Board or Securock, maximum length to minimize end joints unless indicated otherwise. Certainteed Gypsum Canada, CGC Inc. or G-P Products.

2.4 ACCESSORIES

.1 Acoustic Insulation: Refer to Section 07 21 16

.2 Acoustic Sealant: CGSB 19-GP-21M; Single component, Non-hardening, non-skinning, for use in conjunction with gypsum board; synthetic rubber sealant. Acoustical Sealant by Tremco.

.3 Hanger wires: 4.1 mm minimum diameter galvanized pencil rod.

.4 Tie wire: 1.6 mm thick minimum diameter, soft annealed, galvanized steel wire.

.5 Corner Beads: Corner bead, casing bead, and special shapes: Formed from 0.6 mm thick minimum, galvanized steel sheet, designed to be concealed by joint compound.

.6 Edge Trim: GA-201 and GA-216; Type LC

.7 Joint Materials: ASTM C475; GA-201 and GA-216; reinforcing tape, joint compound, adhesive, and water.

.8 Control joint strip: Roll formed from galvanized steel sheet, with a tape protected recess, 6 mm wide x 11 mm deep.

.9 Concrete anchors: tie wire sleeve anchors, ‘Redi-Drive TW' by Red Head or approved alternative.

.10 Joint reinforcing tape: ASTM C475; 50 mm wide x 0.25 mm thick, perforated paper, with chamfered edges, unless otherwise recommended by the gypsum board manufacturer.

.11 Bonding adhesive: Type for purpose intended and as recommended and approved by manufacturer.

.12 Joint and patching compound: ASTM C475; Asbestos-free, supplied by manufacturer of gypsum board used.

.13 Fast setting patching compound: ASTM C475; Asbestos-free, Sheetrock or Durabond by CGC Inc., ProRoc products by Certainteed Gypsum Canada or approved alternative.

.14 Access doors: Supplied by other Sections for installation as part of the Work of this Section.

PART 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation

.2 Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings and instructed by the manufacturer.

3.2 METAL STUD INSTALLATION

.1 Install studs in accordance with ASTM C754, GA-201, GA-216, GA-600 and manufacturer's written instructions.

.2 Refer to Drawings for indication of partitions extending stud framing through the ceiling to the structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.

.3 Door Opening Framing: Install double studs at door frame jambs. [Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.

.4 Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, wood frame opening, toilet accessories, and hardware.

3.3 FURRING FOR FIRE RATINGS

.1 Install furring as required for fire resistance ratings indicated to GA-600 requirements and ULC testing.

3.4 SHAFT WALL INSTALLATION

.1 Shaft Wall Framing: In accordance with manufacturer's installation instructions and GA-600 requirements.

3.5 STRUCTURAL CEILING FRAMING INSTALLATION

.1 Install in accordance with ASTM C754, GA-201 and GA-216 and manufacturer's written instructions.

.2 Install metal stud framing members, brackets and accessories as required. Utilize walls, columns and other structural members to create structural ceiling system.

.3 Metal stud structural system to be free of any hanger wires.

.4 Install Gypsum Board on ceiling as noted in Paragraph 3.8.

3.6 SUSPENSION CEILING FRAMING INSTALLATION

(ALL CEILINGS WITH GWB FINISHING, UNLESS NOTED OTHERWISE)

.1 Install in accordance with ASTM C754, GA-201, GA-216 and manufacturer's written instructions.

.2 Coordinate location of hangers with other work.

.3 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

.4 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

.5 Install additional hangers at lighting fixture and ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.

.6 Install ceiling framing independent of walls, columns, and above ceiling work.

.7 Laterally brace entire suspension system.

.8 Install main carrying channels transverse to structural framing members. Lap main carrying channels 200 mm minimum at splices and wire each end with two loops and prevent clustering or lining-up of splices.

.9 Install furring channels at 400 mm o.c., not less than 25 mm, and not more than 150 mm from perimeter walls, at openings, at interruptions in ceiling continuity, and at change in plane. Install furring channels to a tolerance of 3 mm maximum in 3600 mm.

.10 Install additional main carrying and furring channels to frame and to reinforce openings such as recessed lighting fixtures, access hatches, ceiling grilles, outlet boxes, ventilating outlets and similar items.

3.7 ACOUSTIC ACCESSORIES INSTALLATION

.1 Install resilient channels at maximum 600 mm on centre. Locate joints over framing members. Install on interior face of three washrooms on ground floor level.

.2 Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

.3 Install acoustic insulation and acoustic sealant within partitions in accordance with manufacturer's written instructions. Install acoustic sealant at penetrations as required, concealed from view in the final inspection.

3.8 GYPSUM BOARD INSTALLATION

.1 Install gypsum board in accordance with GA-201, GA-216, GA-600 and manufacturer's instructions.

.2 Erect single layer standard gypsum board horizontally. Locate with ends and edges occurring over firm bearing/supporting members.

.3 Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.

.4 Erect exterior gypsum sheathing horizontally, with edges butted tight and ends occurring over firm bearing.

.5 Use screws when fastening gypsum board to metal furring or framing.

.6 Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.

.7 Install gypsum board in lightly butted contact at edges and ends and with 1.6 mm maximum open space between boards; do not force gypsum board into place. Do not install imperfect, damaged or damp boards.

.8 Install gypsum board butting paired tapered edge joints, and mill-cut or field-cut end joints; do not place tapered edges against cut edges or ends.

.9 Do not locate joints within 200 mm of corners or openings, except where control joints occur at jamb lines or where openings occur adjacent to corners. Where necessary, place a single vertical joint over the centre of wide openings.

.10 Cut, drill and patch gypsum board as may be necessary to accommodate the Work of other trades.

.11 Fire Separations:

.1 Construct gypsum board assemblies, where located, in accordance with tested assemblies to obtain required or indicated fire rated assemblies. As a minimum fire separations shall consist of metal framing covered on both sides by fire-rated gypsum board.

.2 Install assemblies tightly to enclosing constructions to maintain integrity of the separations. Install casing beads at all perimeter edges.

3.9 CORNER, CASING, BEADS AND TRIM

.1 Corner reinforcing bead: Install along all external angles, erect plum b, level and with a minimum of joints. Secure with screws at 225 mm o.c. apply filler over flanges flush with nose of the bead and extending at least 75 mm onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.

.2 Casing bead: Install where wallboard butts against a surface having no trim concealing the juncture and where shown on drawings. Erect casing beads plumb or level, with minimum joints, and secure with screws at 300 mm o.c. apply filler over flange flush with bead and extending at least 75 mm onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.

.3 Recess channels and trim: Install recess channels and special metal trim where shown. Secure to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

3.10 JOINT TAPING AND FINISHING

.1 Install reinforcing tape and a minimum of 3 coats of joint compound over gypsum board joints, metal trim and accessories, and screw fasteners in accordance with the gypsum board manufacturer's instructions.

.2 Fill gaps between, and any imperfections in, gypsum boards with joint compound, allow to dry, and sand smooth ready for painting.

.3 Install finished gypsum board Work smooth, seamless, plum b, true, flush, and with square, plumb, and neat corners.

.4 Finish gypsum board in accordance with ASTM C840 to the following grades:

.1 Level 0: No taping, finishing, or accessories required. Use above suspended ceilings and within other concealed spaces, unless the assembly is fire rated, sound rated, sound or smoke controlled, or unless the space serves as an air plenum.

.2. Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable. Use above suspended ceilings and within other concealed spaces if the gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or the space serves as an air plenum.

.3 Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories. Use for water resistant gypsum board indicated for use as a substrate for ceramic tile.

.4 Level 3: At joints and interior angles embed tape in joint compound with two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use where heavy grade wall coverings are the final decoration.

.5 Level 4: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use for all locations except those indicated for other finish levels.

.6 Level 5: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound, or a material manufactured especially for this purpose, to the entire surface. Leave surface smooth and free of tool marks and ridges. Use where semi-gloss or gloss finish coatings are the final decoration.

3.11 ACCESS DOORS

.1 Install access doors supplied as part of other parts of the Work.

3.12 SITE TOLERANCES

.1 Install metal support systems to ensure that, within a tolerance of +3 mm and -1.5 mm for plaster thickness, finish surfaces will be flat within 3 mm under a 3 m straightedge, and with no variation greater than 1.5 mm in any running 300 mm, and that surface planes shall be within 3 mm of dimensioned location.

3.13 REPAIR

.1 Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.

.2 Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Non-load bearing steel framing includes non-load bearing steel studs framing members for interior framing systems (eg., partition walls, framed bulkheads, furring, shaft wall, etc.) as well as interior suspension systems (eg., supports for ceilings, suspended bulkheads, etc.).

.2 Framing accessories.

1.2 RELATED SECTIONS

.1 Section 05 40 00 - Cold-Formed Metal Framing

.2 Section 06 10 00 – Rough Carpentry

.3 Section 07 21 13 – Board Insulation

.4 Section 07 26 00 – Air Barrier, Air/Vapour Retarders

.5 Section 08 12 13 –Metal Doors and Frames

.6 Section 08 20 00 – Wood Doors and Frames

.7 Section 09 12 16 – Gypsum Board

.8 Section 09 81 00 – Acoustic Batt Insulation

1.3 REFERENCES

.1 National Building Code

.2 Ontario Building Code

.3 ASTM A123/A123M - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.4 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM C645 - Standard Specification for Non-Structural Steel Framing Members.

.6 ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

.7 ASTM A924 General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.8 ASTM A568 Steel Sheet, Carbon, and High-Strength, Low Alloy, Hot Rolled and Cold Rolled.

.9 ASTM A792 Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.10 CAN/CGSB-7.1M Cold Formed Steel Framing Components

.11 CAN/ULC-S101-M89 Standard Methods of Fire Endurance Tests of Building Construction Materials.

.12 CAN/CGSB-19.21 Sealing and Bedding Compound Acoustical.

1.4 SCOPE OF WORK

.1 Provide labour, materials, services and equipment necessary to complete installation of the lightweight steel framing system including:

.1 Wall studs subjected to lateral loads (no axial load other than self-weight and the weight of applied finishes.)

.2 Steel bridging.

.3 Top and bottom track.

.4 Head and sill members and jamb studs for wall opening.

.5 Stud, bridging and track connections.

.6 Top and bottom track connections to main structure including details to accommodate floor deflections.

.2 Wall System:

.1 Design to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

.2 Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.5 DESIGN CRITERIA

.1 Fire rated assembly walls, where indicated.

.2 Select studs with maximum deflection of L/360 at lateral force of 5psf (240 Pa) for maximum heights indicated.

.3 Select studs for horizontal spacing as noted.

.4 Select studs for application of one or multiple layers of gypsum board as indicated.

.5 Design stud and track connections to accommodate vertical deflection movement of the structure without imposing axial loads onto the framing.

.6 Provide rows of continuous horizontal bridging channels maximum 1500mm on centre to resist applied loads.

.7 Provide additional framing members as required to reinforce and frame openings in partitions.

.8 Use resilient furring channels on one side of wall and acoustical cavity insulation and acoustical insulation and acoustical sealant to achieve minimum STC levels indicated.

1.6 SUBMITTALS FOR REVIEW

.1 Section 01 33 00 - Submittal Procedures

.2 Shop Drawings:

.1 Indicate component details, gauges, stud layout, framed openings, anchorage to structure, type and location of fasteners, and accessories or items required of other related work.

.2 Describe method for securing studs to tracks, splicing, and for blocking and reinforcement to framing connections.

.3 Product Data: Provide data describing standard framing member materials and finish, product criteria, load charts and limitations.

.4 Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.7 QUALITY ASSURANCE

.1 Perform Work in accordance with ASTM C754.

.2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience supported by written certification by manufacturer.

.3 Design structural elements under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the Province of Ontario.

.4 Form, fabricate, install, and connect components in accordance with ML/SFA 540.

PART 2 Products

2.1 MANUFACTURERS

.1 Bailey Metal Products Limited
One Caldari Road
Concord, ON L4K
1-800-668-2154

.2 CGC Shaft Wall Systems.

.3 Substitutions: Refer to Section 01 62 00 – Product Exchange Procedures

2.2 MATERIALS

.1 Materials for fire rated assemblies to conform to the requirements of the specified listing.

.2 Stud width(s) to be as indicated and to include minimum 20 gauge factory pre-punched cut outs for services and channel bridging.

.3 Bailey Steel stud framing for screw attachment of gypsum board, roll formed from cold formed steel with either Galvalume or minimum G60 (Z180) galvanized coating.

.4 Top track to be of same material as studs and sized to suit. Leg length of top track to be 50mm.

.5 Bottom track to be of same material as studs and sized to suit stud. Leg length of bottom track to be 124mm.

.6 Bridging channel 38mm x 13mm roll formed from 0.048” (1.22mm) thick cold formed steel with minimum G60 (Z180) galvanized coating or equivalent.

.7 Fasteners to secure metal framing together to be No. 8 x 9/16” Wafer Head Speed Tec Framing Screw.

.8 Resilient channel roll formed from 0.018” (0.46mm) thick cold formed galvanized steel.

.9 Acoustic Sealant: As specified in Section 07 92 00 – Joint Sealants.

.10 Touch-Up Primer for Galvanized Surfaces: SPCC - Paint 20 zinc rich.

2.3 FABRICATION

.1 Fabricate assemblies of framed sections to sizes and profiles required.

.2 Fit, reinforce, and brace framing members to suit design requirements.

.3 Fit and assemble in largest practical sections for delivery to site, ready for installation.

2.4 FINISHES

.1 Studs: Galvanize to Z275.

.2 Tracks and Headers: Galvanize to Z275.

.3 Accessories: Same finish as framing members.

PART 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 – Examination and Preparation

.2 Verify that rough-in utilities are in proper location.

.3 Fabrication and erection shall conform to the approved shop drawings. Modifications required to accommodate as-built conditions shall be submitted for approval.

.4 Provide necessary studs, framing and furring systems to provide proper support for gypsum board in accordance with good industry practice.

.5 Provide cooperation to other trades to accommodate window and door frames, mechanical and electrical items and any other work required to be incorporated into or coordinated with the framing system.

3.2 ERECTION

.1 Erect partitions requiring fire rating in accordance with requirements of listing

.2 Align tracks at top and bottom of partitions and secure 600mm on centre maximum, and maximum 50mm from each end.

.3 Place studs vertically as indicated and maximum 50 mm. from abutting walls and each side of corners and openings.

.4 Install partition to accommodate vertical deflection of structure without imposing axial loads onto the framing.

.5 Install partitions to underside of structure above as indicated.

.6 Attach studs to track.

.7 Install double studs at jambs and double tracks at heads of door openings, not more than 50mm from each side of opening.

.8 Fabrication corners using a minimum of three studs.

.9 Provide solid blocking, additional framing and reinforcing to support wall mounted fixtures and door stops as indicated.

.10 Install resilient furring channel transverse to framing members. Start rows of channel 50mm up from floor and within 150mm from ceiling. Space rows at maximum 610mm. Locate splices over framing and secure channel ends to framing. Secure to framing with sheet metal framing screws. End joints to be staggered and aligned over framing and each end fastened to framing.

.11 Install acoustical sealant/insulating gasket under tracks.

.12 Finished work to be rigid, secure, square, level, plumb and curved to detailed radius and erected to maintain dimensions and contours.

.13 Coordinate placement of insulation in stud spaces after stud frame erection.

3.3 ERECTION TOLERANCES

.1 Maximum Variation From True Position: 3 mm in 3 m].

.2 Maximum Variation From Plumb: 3 mm in 3 m.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for exterior cement parging Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

.2 ASTM C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

.3 ASTM C348, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.

.4 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.

.5 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

.1 Product Data: submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:.

.1 Performance criteria, compliance with appropriate reference standard(s), characteristics, limitations, and trouble-shooting protocol.

.2 Product transportation, storage, handling and installation requirements.

.2 Samples: two 300x300mm samples of parging finish and colour.

1.4 QUALITY ASSURANCE

.1 Perform Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of cement parging work of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator’s current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:

.1 Construct one 2 m^2 mock-up of cement parging system in location acceptable to Consultant.

.2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.

.3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

.4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials in original unopened packages, with each package bearing legible labels identifying manufacturer, product name and grade, contents, colour and product standard.

.2 Store tightly sealed materials off ground and away from moisture, direct sunlight, extreme heat, and freezing temperatures.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not install install Work of this Section outside of manufacturer recommended environmental ranges without Consultant's and Product manufacturer's written acceptance.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

PART 2 Products

2.1 MATERIALS

.1 Parging:

.1 Cement-based, waterproof coating for concrete substrates as indicated. ‘Thoroseal Plaster Mix’ by Degussa or approved alternative.

.2 Colour: Gray colour as selected by the Consultant. Provide samples for the Consultant’s approval.

.3 Parging to meet the following minimum requirements:

.1 Compressive Strength: ASTM C109/C109M; 28 Days: 27.6 MPa.

.2 Flexural Strength: ASTM C348; 28 Days: 900 psi (6.2 MPa).

.3 Tensile Strength: 2.2 MPa per ASTM D412 at 28 days.

.4 Water Absorption: 3.38 percent, per ASTM C67 28 day submersion.

.5 Water-Vapour Permeance: 21.89 perms per ASTM E96.

2.2 MIXES

.1 Mix cement parging in accordance with manufacturer’s written instructions.

.2 Use method of measuring materials to ensure that proportions can be accurately maintained from batch to batch.

.3 Stir or mix to uniform consistency, as recommended by manufacturer. Use mixed material before manufacturer's recommended pot life has expired. Keep containers closed when not in use.

PART 3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 PREPARATION

.1 Prepare intended substrates in accordance with manufacturer's written instructions.

.2 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and any other foreign matter detrimental to performance.

.3 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section. Do not plaster adjacent to aluminum or other finished work until such work is masked.

3.3 APPLICATION

.1 Trowel apply and cure cement parging in accordance with manufacturer's written instructions.

.2 Trowel and float finish:

.1 When key coat of parging has cured for 24 to 48 hours, apply trowel coat of parging plaster mix. Use manufacturer recommended steel trowel to firmly press material into voids and to level it. When surface is set so that it will not roll or lift, follow with sponge float. Float surfaces uniformly.

.2 Apply sufficient material to thoroughly fill all voids and pores and level uneven surfaces.

.3 Provide 6 mm thick parging over concrete substrates and in locations indicated on Contract Drawings.

3.4 REPAIR

.1 Touch up and refinish minor defective areas. Refinish entire coated surface where finish is damaged or otherwise unacceptable.

3.5 CLEANING

.1 Remove promptly as application progresses spilled or spattered materials from adjacent surfaces. Do not mar surfaces while removing.

.2 Leave storage and mixing areas clean and in same condition as equivalent spaces in Project.

3.6 PROTECTION

.1 Protect finished adjoining work, during execution of parging work, with polyethylene sheets or building paper.

.2 Remove surplus material, tools, equipment and debris from work area on completion of work.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Ceramic tile finish using the thinset application method.

1.2 RELATED SECTIONS

.1 Section 01 21 00 - Allowances

.2 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCES

.1 TTMAC (Terrazzo, Tile, and Marble Association of Canada) - Manual.

1.4 SUBMITTALS

.1 Shop Drawings: Indicate tile layout, patterns, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

.2 Product Data: Provide instructions for using adhesives and grouts.

1.5 MAINTENANCE DATA

.1 Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.6 QUALITY ASSURANCE

.1 Perform Work in accordance with TTMAC Manual

.2 Maintain one copy of each document on site.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

.2 Installer: Company specializing in performing the work of this section with minimum 3 years' experience.

1.8 MOCK-UP

.1 Construct mock-up, 2 feet long by 2 feet wide, with finish grout, and specified accessories.

.2 Locate where directed.

.3 Mock-up may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00 – Product Requirements: as per manufacturer's written directions.

.2 Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

.1 Do not install adhesives in an unventilated environment.

.2 Maintain 10 degrees C during installation of mortar materials.

1.11 EXTRA MATERIALS

.1 Provide 10 sq ft of each size, colour, and surface finish of tile specified.

PART 2 Products

2.1 TILE MANUFACTURERS

.1 Stone Tile.

.2 Substitutions: Not permitted.

2.2 CERAMIC TILE MATERIALS

.1 Refer to Finish Schedule and Details

2.3 MORTAR MATERIALS

.1 Manufacturers: as recommended by Tile Manufacturer.

2.4 MORTAR MIX AND GROUT MIX

.1 Mix and proportion pre-mix setting bed and grout materials in accordance with manufacturer's instructions.

2.5 WALL TILE ACCESSORY MANUFACTURERS

.1 Schluter Systems

.2 Profilitec

PART 3 Execution

3.1 EXAMINATION

.1 Verify that surfaces are ready to receive work.

3.2 PREPARATION

.1 Protect surrounding work from damage or disfiguration.

.2 Vacuum clean surfaces and damp clean.

.3 Seal substrate surface cracks with filler. If specifying a cleavage membrane, delete the following paragraph.

.4 Apply sealer to substrate surfaces in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - THINSET METHOD

.1 Install adhesive tile and grout in accordance with manufacturer's instructions.

.2 Lay tile, trim and accessories to pattern indicated. Do not interrupt tile pattern through openings.

.3 Cut and fit tile tight to penetrations through tile. Form corners and bases neatly.

.4 Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

.5 Form internal and external angles square.

.6 Sound tile after setting. Replace hollow sounding units.

.7 Keep control joints free of adhesive or grout. Apply sealant to joints.

.8 Allow tile to set for a minimum of 48 hours prior to grouting.

.9 Grout tile joints.

.10 Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.4 CLEANING

.1 Clean tile and grout surfaces.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Resilient tile flooring.

1.2 RELATED SECTIONS

.1 Section 06 10 00 – Rough Carpentry

1.3 REFERENCES

.1 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM F1066 - Vinyl Composition Floor Tile.

.3 ASTM F1861 - Resilient Wall Base.

.4 FS L-F-1641 - Floor Covering Translucent or Transparent Vinyl Surface with Backing.

.5 FS L-F-475 - Floor Covering, Vinyl Surface (Tile and Roll), with Backing.

.6 FS RR-T-650 - Treads, Metallic and Non-metallic, Non-skid.

.7 FS SS-W-40 - Wall Base: Rubber and Vinyl Plastic.

1.4 SUBMITTALS

.1 Section 01300: Submission procedures.

.2 Shop Drawings: Indicate seaming plan and patterns.

.3 Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colours available.

.4 Samples: Submit 1 sample, 6” x 6” in size illustrating colour and pattern for each floor material for each colour specified.

.5 Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 REGULATORY REQUIREMENTS

.1 Conform to flame/smoke rating requirements in accordance with ASTM E84.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Section 01600: Deliver, store, protect and handle products to site.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Store materials for three days prior to installation in area of installation to achieve temperature stability.

.2 Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

1.8 MAINTENANCE DATA

.1 Section 01700: Submission procedures.

.2 Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.9 EXTRA MATERIALS

.1 Section 01700: Extra materials.

.2 Provide 1 box of each material specified.

PART 2 Products

2.1 MATERIALS - TILE FLOORING

.1 Linoleum:

.1 Total Thickness: 0.1 inch

.2 Tile Size: 19.69 inch x 9.84 inch

.3 Manufacturers: Forbo Flooring system.

.4 Style: Marmoleum Modular. Colour #3568 Delta Lace.

2.2 MATERIALS - BASE

.1 Base: Replicated wood base. Refer to drawing.

2.3 ACCESSORIES

.1 Subfloor Filler: Type recommended by adhesive material manufacturer.

.2 Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

.3 Edge Strips: Refer to drawing.

.4 Cant Strip: Plastic.

.5 Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 Execution

3.1 EXAMINATION

.1 Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting.

.2 Verify floor and lower wall surfaces are free of substances that may impair adhesion of new adhesive and finish materials.

3.2 PREPARATION

.1 Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

.2 Prohibit traffic until filler is cured.

.3 Vacuum clean substrate.

3.3 INSTALLATION - TILE FLOORING

.1 Install in accordance with manufacturer's instructions.

.2 Install 1/2 inch plywood underlayment on top of deck board.

.3 Mix tile from container to ensure shade variations are consistent when tile is placed.

.4 Spread only enough adhesive to permit installation of materials before initial set.

.5 Set flooring in place, press with heavy roller to attain full adhesion.

.6 Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

.7 Install tile to ashlar pattern. Allow minimum ½ full size tile width at room or area perimeter.

.8 Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.

.9 Install resilient edge strips at unprotected or exposed edges, and where flooring terminates.

.10 Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

.11 Install flooring in pan type floor access covers. Maintain floor pattern.

.12 At movable partitions install flooring under partitions without interrupting floor pattern.

.13 Install edge strips where indicated. Fit joints tightly.

3.4 CLEANING

.1 Section 01700: Clean Work.

.2 Remove access adhesive from floor, base, and wall surfaces without damage.

.3 Clean, seal, and wax floor and base surfaces in accordance with manufacturer's instructions.

3.5 PROTECTION OF FINISHED WORK

.1 Section 01700: Protect finished Work.

.2 Prohibit traffic on floor finish for 48 hours after installation.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary to complete Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 ASTM D2859 - Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

.2 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM E648 - Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

.4 NFPA 253 - Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

.1 Section 01300: Submission procedures.

.2 Shop Drawings: Indicate starting point, layout of joints and direction of carpet weave.

.3 Product Data: Provide data on specified products, describing physical characteristics; sizes, patterns, colours available, and method of installation.

.4 Samples: Submit one carpet tiles illustrating colour.

.5 Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.4 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the specified carpet in this Section with minimum five years of experience.

.2 Installer: Company specializing in performing the work of this Section with minimum 5 years documented experience.

1.5 REGULATORY REQUIREMENTS

.1 Conform to carpet flammability requirements in accordance with ASTM E84.

.2 Conform to ASTM D2859 for surface flammability ignition test.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Store materials for 3 days prior to installation in area of installation, to achieve temperature stability.

.2 Maintain minimum 21 degrees C ambient temperature three days prior to, during and 24 hours after installation materials.

1.7 MAINTENANCE DATA

.1 Section 01700: Submission procedures.

.2 Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.8 EXTRA MATERIALS

.1 Section 01700: Submission procedures.

.2 Provide 1 carton of carpet tiles of each colour and pattern selected.

PART 2 Products

2.1 CARPET TILE

.1 Carpet Tile:
- .1 Collection: Hand Drawn
- .2 Style: Stipple Tile
- .3 Tile Size: 18” x 36”
- .4 Colour: Graphite #13510
- .5 Pattern: Herringbone.

2.2 ACCESSORIES

.1 Sub-Floor Filler: Recommended by flooring material manufacturer.

.2 Primers and Adhesives: Recommended by carpet manufacturer.

.3 Transition strips. Refer to drawing.

PART 3 Execution

3.1 EXAMINATION

.1 Verify that surfaces are smooth and flat with maximum variation of 1/4 inch in 10 ft, and are ready to receive work.

.2 Verify concrete or wood deckboards are dry; and exhibit negative alkalinity, carbonization, or dusting.

3.2 PREPARATION

.1 Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

.2 Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

.3 Vacuum clean substrate.

3.3 INSTALLATION

.1 Install carpet tile, accessories and adhesive in accordance with manufacturer's instructions.

.2 Integrate and blend carpet from different cartons to ensure minimal variation in colour match.

.3 Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

.4 Lay carpet tile to herringbone pattern, tile direction parallel to Grid A.

.5 Locate change of colour or pattern between rooms under door centerline.

.6 Fully adhere carpet tile to substrate.

3.4 CLEANING

.1 Section 01700: Submission procedures.

.2 Remove excess adhesive without damage, from floor, base, and wall surfaces.

.3 Clean and vacuum carpet surfaces.

3.5 PROTECTION OF FINISHED WORK

.1 Section 01700: Protect finished Work.

.2 Do not permit traffic over unprotected floor surface.

3.6 SCHEDULES

.1 Refer to drawings.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Surface preparation and field application of paints and coatings.

.2 Existing exterior/interior wood elements and new wood doors and trims are under Section 09 03 98 – Restoration Painting and Coating. Balance of painting required to complete the Work is under this Section.

1.2 RELATED SECTIONS

.1 Section 05 12 00 – Structural Steel Framing.

.2 Section 05 31 13 – Steel Floor Decking.

.3 Section 05 31 23 – Steel Roof Decking.

.4 Section 05 41 00 – Cold Form Metal Framing.

.5 Section 05 50 00 Metal Fabrications

.6 Section 05 52 00 – Metal Railings.

.7 Section 06 20 00 – Finish Carpentry.

.8 Section 08 11 13 – Metal Doors and Frames

.9 Section 09 21 16 – Gypsum Board

1.3 REFERENCES

.1 ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials and Applications.

.2 AWWA (American Water Works Association) - C218 - Standard for Coating the Exterior of Aboveground Steel Water Pipelines & Fittings.

.3 MPI (Master Painters Institute) - Specifications Manual.

.4 SSPC (The Society for Protective Coatings) (formerly SSPC - Steel Structures Painting Council) - Steel Structures Painting Manual.

1.4 DEFINITIONS

.1 Conform to ASTM D16 for interpretation of terms used in this Section.

1.5 SUBMITTALS

.1 Section 01 33 00 – Submittal Procedures.

.2 Product Data: Submit in writing a list of all materials. Provide data on all finishing products.

.3 Samples: Submit two (2) samples, 100mm x 150mm in size illustrating range of colours and textures available for each surface finishing product scheduled.

.1 Each sample to be labeled with project title, finish, formula, colour name, number, sheen and gloss value, date, name of contractor and subcontractor.

.4 Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention and recommended application methodology.

1.6 QUALITY ASSURANCE

.1 Finishing Work: Perform work to MPI requirements for premium grade.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

.2 Applicator: Company specializing in performing the work of this section with minimum five (5) years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 Conform to applicable code for flame and smoke rating requirements for finishes.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

.2 Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, colour designation, and instructions for mixing and reducing.

.3 Store paint materials at minimum ambient temperature of 7 degrees Celsius and a maximum of 32 degrees Celsius, in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

.1 Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

.2 Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

.3 Minimum Application Temperatures for Latex Paints: 7 degrees Celsius for interiors; 10 degrees Celsius for exterior; unless required otherwise by manufacturer's instructions.

.4 Minimum Application Temperature for Varnish and Stains Finishes: As per Manufacturer's written instructions.

.5 Provide lighting level of 860 lx measured mid-height at substrate surface.

1.11 EXTRA MATERIALS

.1 Section 01 78 10 – Closeout Submittals.

.2 Provide one (1) gallon of each colour, type, and surface texture to Owner.

.3 Label each container with colour, type, texture, room locations, and in addition to the manufacturer's label.

1.12 WARRANTY

.1 Provide unconditional one (1) year warranty for painting.

PART 2 Products

2.1 MANUFACTURERS

.1 Acceptable manufacturers:
- .1 Benjamin Moore
- .2 Akzo Nobel (Dulux Paints)
- .3 Para Painting & Coatings
- .4 PPG Canada Industries Limited
- .5 Sherwin Williams

2.2 MATERIALS

.1 General
- .1 Only 'top-line' products produced by their manufacturers are acceptable.
- .2 Use only products of manufacture whose best quality lines meet or exceed CGSB Specifications, except where otherwise specified by reference to another material of a specific manufacturer.
- .3 Other finishing materials such as oils, shellacs, putties, thinners and other materials required for specified finishes shall be of the best quality produced or recommended by the manufacturer approved for supply of applicable finish materials.

.2 Products in accordance with the MPI Painting Specification Manual, Exterior and Interior Systems;
- .1 Manufacturer's premium grade, first line Products.
- .2 Uniform dispersion of pigment in a homogenous mixture.
- .3 Ready-mixed and tinted whenever possible.

.3 Products within each MPI paint system code: From single manufacturer.

.4 Water shall be clean and potable.

.5 Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

.6 Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.3 COLOUR SCHEDULE

.1 Consultant will select choice of colours and gloss when compiling a Colour Schedule after award of Contract; allow for colour selection beyond paint manufacturer's standard colour range.

.2 Refer to Colour Schedule for selected colour references.

.3 Conform to gloss reflectance definitions listed in MPI Specification Manual.

2.4 PAINTING AND FINISHING SCHEDULE

.1 REFER TO Table1, MPI Painting and Finishing Schedule coded systems, comply with MPI Painting Specification Manual.

Table 1: Painting and Finishing Schedule

EXTERIOR SUBSTRATES	Typical substrates (including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Structural steel and metal fabrication	Entrance canopy and related structural components	Pitt-Tech 4020 by PPG for shop prime and touch up on damaged spots Pitt-Tech Plus/90-1110 series for top coat		Acrylic
Galvanized steel	HM doors and frames	EXT 5.3	EXT 5.3B	Alkyd
Wood paneling	Soffit	EXT 6.4	EXT 6.4K	Latex

INTERIOR SUBSTRATES	Typical substrates (including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Concrete walls and ceiling		INT 3.2	INT 3.2A	Latex
Concrete Floor	Make good of epoxy floor at Apparatus Bays 101 only	INT 3.2	INT 3.2C	Epoxy
Concrete Block Masonry		INT 4.2	INT 4.2A	Latex
Structural steel and metal fabrications		INT 5.1	INT 5.1E	Alkyd
Galvanized Metal	HM doors and door frames, handrails	INT 5.3	INT 5.3B	WB light industrial coating
Wood paneling and casework	Partitions, panels, millwork	INT 6.4	INT 6.4C	Semi-transparent stain
Wood paneling and casework	Kitchen and vanity millwork	INT 6.4	INT 6.4E	Polyurethane
Gypsum board and cement boards	Drywall, walls, ceilings	INT 9.2	INT 9.2A	Latex

PART 3 Execution

3.1 EXAMINATION

.1 Verify site conditions.

.2 Verify that substrate conditions are ready to receive work as instructed by the product manufacturer.

.3 Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

.4 Test shop applied primer for compatibility with subsequent cover materials.

.5 Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

.1 Plaster and Gypsum Wallboard: 12 percent.

.2 Interior Wood: 15 percent, measured in accordance with ASTM D2016.

.3 Exterior Wood: 15 percent, measured in accordance with ASTM D2016.

3.2 PREPARATION

.1 Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

.2 Correct defects and clean surfaces which affect work of this section.

.3 Seal with shellac and seal marks which may bleed through surface finishes.

.4 Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

.5 Galvanized steel sheet:
- .1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
- .2 ZF0765 (Wiped Coat): Remove contamination, wash with Xylene solvent.
- .3 Touch-up damaged galvanized area with organic zinc rich primer.

.6 Structural steel and miscellaneous metal fabrications:
- .1 Co-ordinate the following with the responsible trades:
  - .1 Rust, mars, mill scale, and weld-burn tourch-ups.
  - .2 Oil, grease, weld flux and other residue removal.
- .2 Prime paint items.
- .3 Touch-up damaged galvanized area with organic zinc rich primer.

.7 Metal Doors and frames Scheduled for Painting: Seal top and bottom edges with primer.

.8 Galvanized steel sheet
- .1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
- .2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
- .3 Touch-up damaged galvanized areas with organic zinc rich primer.

.9 Structural steel and miscellaneous metal fabrications:
- .1 Coordinate the following with the responsible trades:
  - .1 Rust, mars, mill scale, and weld-burn touch-ups.
  - .2 Oil, grease, weld flux and other residue removal.
- .2 Prime paint items, not otherwise indicated to be primed as part of another section
- .3 Touch-up damaged galvanized areas with organic zinc primer.

.10 Factory primed surfaces:
- .1 Touch up damaged areas.
- .2 Clean as required for top coat.

.11 Coordinate with other trades to prevent:
- .1 Damage and inadvertent activation of fire and smoke detectors.

.2 Odour and dust distribution by permanent HVAC systems including fouling of ducts and filters.

.12 Field-mix Products in accordance with manufacturer's written instructions.

3.3 APPLICATION

.1 Apply products in accordance with MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.

.2 Painted surfaces to receive at minimum 1 prime coat (2 coats of prime in high traffic areas) and 2 finish coats. Coordinate with Consultant where 2 prime coats are required.

.3 Do not apply finishes to surfaces that are not dry.

.4 Apply each coat to uniform finish.

.5 Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

.6 Sand wood and metal lightly between coats to achieve required finish.

.7 Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

.8 Allow applied coat to dry before next coat is applied.

.9 Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

.10 Prime concealed surfaces of interior and exterior woodwork with primer paint.

.11 Prime concealed surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

3.4 FINISHING MECHANICAL, ELECTRICAL EQUIPMENT AND EXPOSED STRUCTURE

.1 All existing and new duct work, piping and conduit to be painted colour to match adjacent wall/ ceiling unless otherwise required by code.

.2 Remove unfinished louvres, grilles, covers, and access panels on mechanical and electrical components and paint separately.

.3 Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished.

.4 Paint exposed conduit and electrical equipment occurring in finished areas.

.5 Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

.6 Paint all exposed structural steel components for entrance canopy.

.7 Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 CLEANING

.1 Section 01 74 00 – Cleaning and Waste Processing

.2 Remove spilled or splattered finish materials from surfaces of Work performed under other Sections. Do not mar surfaces while removing.

.3 Leave storage and mixing areas clean and in same condition as equivalent spaces in Project.

.4 Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Toilet and washroom accessories.

.2 Grab bars.

.3 Attachment hardware.

1.2 RELATED SECTIONS

.1 Section 09 30 00 - Tiling

1.3 REFERENCES

.1 ANSI A117.1 - Accessible and Usable Buildings and Facilities.

.2 ASTM A123/A123M - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.4 ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.5 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low Alloy and High Strength Low Alloy with Improved Formability.

.6 ASTM B456 - Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

.7 NEMA LD-3 - High Pressure Decorative Laminates.

1.4 SUBMITTALS

.1 Section 01300: Submission procedures.

.2 Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

.3 Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 REGULATORY REQUIREMENTS

.1 Conform to ANSI A117.1 code for access for the handicapped.

1.6 FIELD MEASUREMENTS

.1 Verify that field measurements are as indicated.

1.7 COORDINATION

.1 Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

PART 2 Products

2.1 MATERIALS

.1 Stainless Steel Sheet: ASTM A167, Type 304.

.2 Tubing: ASTM A312, Type 304.

.3 Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.

PART 3 Execution

3.1 EXAMINATION

.1 Section 01700: Verify site conditions.

.2 Verify that site conditions are ready to receive work and dimensions are as [indicated on shop drawings.] [instructed by the manufacturer.]

.3 Verify exact location of accessories for installation.

3.2 PREPARATION

.1 Deliver inserts and rough-in frames to site for timely installation.

.2 Provide templates and rough-in measurements as required.

3.3 INSTALLATION

.1 Install accessories in accordance with manufacturers' instructions.

.2 Install plumb and level, securely and rigidly anchored to substrate.

3.4 SCHEDULE

.1 Refer to drawings.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary to complete Work in accordance with the Contract Documents.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-Place Concrete

.2 Section 04 20 00 - Unit Masonry.

.3 Section 05 12 00 - Structural Steel Framing.

.4 Section 05 50 00 - Metal Fabrications.

.5 Section 07 13 00: Sheet Membrane Waterproofing.

.6 Section 07 84 00 – Fire Stopping and Smoke Seals.

.7 Section 09 21 16 - Gypsum Board.

.8 Section 09 22 16 – Interior Non-Load Bearing Metal Stud Framing

.9 Section 09 30 00 – Tiling. Floor finish in cab.

.10 Division 21, 22, 23, 25 & 26 – Mechanical and Electrical sections.

1.3 REFERENCES

.1 ANSI/AISC N690 - Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities.

.2 APA (American Plywood Association) Product Guide - Grades and Specifications.

.3 ASTM A36/A36M - Carbon Structural Steel.

.4 ASTM A139 - Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 in. and Over).

.5 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.6 ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Allow With Improved Formability.

.7 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.8 ASTM B221/B221M - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.9 CSA B44/B44S1 - Elevator Safety Code.

.10 CSA B44.1 - Elevator and Escalator Electrical Equipment.

.11 CSA W55.3 - Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.12 NEMA LD-3 - High Pressure Decorative Laminates.

.13 NEMA MG 1 - (Condensed) Motors and Generators.

.14 NFPA 70 - National Electrical Code.

.15 NFPA 80 - Fire Doors, Fire Windows.

.16 SSPC (The Society for Protective Coatings) (formerly SSPC - Steel Structures Painting Council) - Steel Structures Painting Manual.

.17 UL 10B - Fire Tests of Door Assemblies.

.18 ITS (Intertek Testing Services) - Certification Listings.

1.4 DESIGN REQUIREMENT

.1 Hydraulic Elevator: One holeless hydraulic elevator.

.2 Design elevator in compliance with Elevating Devices Act and ASME A17.1/CSA B44 including latest supplements.

.3 Design elevator equipment to fit into space provided for hoistway, overhead and machine rooms shown on Contract Drawings.

.4 Design elevator with roped hydraulic operating and control equipment, direct acting plunger, pump unit, oil storage tank, to-from oil lines, muffler, gate and magnetic control valves. Deliver operating fluid directly into cylinder at necessary pressure and in sufficient quantity to lift rated load at rated speed.

.5 Provide smooth acceleration and deceleration of car without perceptible steps so adjusted as not to cause passenger discomfort.

.6 Design single stage piston to be located at side of car platform.

.7 Design guide rail brackets for attachment to elevator shaft walls as shown on Contract Drawings.

.8 Control: Oil hydraulic with two way levelling.

.9 Characteristics of elevator are as follows:

.1 Rated Net Capacity: 635 kg

.2 Rated Speed: 0.15 m/s

.3 Car Inside Dimensions: 3’-6” wide x 5’-0” deep.

.4 Hoistway Entrance Size: 3’-0” x 6’-8”.

.5 Door Type: Double leaf.

.6 Door Operation: Automatic operator for hoistway and car. Opening and Closing speed to suit handicapped requirements.

.7 Travel Distance: Refer to drawing.

.8 Number of Stops: 3.

.9 Number of Openings: 1 at Front.

1.5 SUBMITTALS FOR REVIEW

.1 Section 01300: Submission procedures.

.2 Shop Drawings: Indicate the following information:

.1 Submit shop drawings in accordance with Section 01 33 00. In addition to the requirements of ASME A17.1/CSA B44, shop drawings shall indicate:

.2 Elevations, sections and details of elevator and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.

.3 Weights of principal components.

.4 Complete electrical wiring diagrams including electrical schematics and sequence of operation.

.5 Complete engineering design data to confirm that elevators meet design criteria specified.

.6 Electrical power information including voltage confirmation sheet, recommended fuse ratings, sizes and types, equipment starting and running current.

.7 Fabrication and installation details of piston and piston casing.

.8 Size and location of machine, controller and piping.

.9 Piping and other connections in machine room.

.10 Size and location of car, hoisting beam, Guides, buffers, buffer supports, oil line connections, and other components in hoistway.

.11 Sizes and locations of cutouts for oil lines and wiring.

.12 Details of work required by other trades.

.13 Rail bracket spacing.

.14 Forces on guide rails, floor, and at other points of support.

.15 Outside diameter and wall thickness of hydraulic piping.

.16 Working pressure.

.17 Rating of drive motor.

.18 Top and bottom clearance and over travel of car.

.19 Location of disconnects, light switches and feeder extension points in machine room.

.20 Heat dissipation rate for elevator equipment in machine room.

.21 Hoistway entrances and doors showing method of operation, details of construction, and method of fastening to structural members of structure.

.22 Car showing details of construction, fastening to platform, lighting, ventilation, and location of car equipment.

.23 Signal and operating fixtures including hall lanterns, car riding lanterns, hall buttons, car position indicator, control switches.

.24 Location of terminal box in machine room and layout of terminal blocks.

.25 Wiring diagram showing connections from each source.

.26 Location in hoistway for connection of traveling cable.

.3 Product Data: Provide data on the following items:

.1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and trouble-shooting protocol.

.2 Signal and operating fixtures, operating panels, indicators, car design and components, doors and frame details, door protective devices, microprocessor controller, and telephone.

.3 Product transportation, storage, handling and installation requirements.

.4 Samples: Submit 1 sample, illustrating cab floor material, cab interior finishes, cab and hoistway door and frame finishes, and handrail material and finish.

.5 Prior to installation of elevator, submit to the Consultant 2 approved copies of submission made to the Technical Standards and Safety Authority (TSSA).

1.6 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 01700: Submission procedures.

.1 Reports and Certificates.

.2 Submit following for each Product for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 10:

.1 Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.

.2 Functional description detailing operation and control of components.

.3 Performance criteria and maintenance data.

.4 Operating instructions and precautions.

.5 Safety precautions.

.6 Component parts availability including names and addresses of spare part suppliers.

.7 Consumables.

.8 Lubrication schedule indicating lubrication points and type of lubricant recommended.

.9 Maintenance and troubleshooting guidelines/protocol, and recommended equipment for analysis and repair.

.10 Final tests and commissioning reports.

.11 Items to be submitted to Consultant: keys, tools, special devices, maintenance materials.

.12 Record drawings.

.13 Description of operation and control equipment.

.14 Lubrication chart.

.15 Equipment maintenance check chart.

.16 Equipment trouble shooting guide and instructions.

.17 Equipment manufacturers parts list, including component manufacturer's parts numbers and identification designations.

.18 Name, address, telephone and facsimile numbers for major component manufacturers.

.3 Manual documents that are larger than standard size sheets shall be neatly folded and housed in large envelopes or drawing pockets. These documents shall be inserted and housed in each manual binder.

1.7 QUALITY ASSURANCE

.1 Include the last sentence of the following paragraph only when the costs of acquiring the specified standards are justified.

.2 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Elevator Work of comparable complexity and scope, to perform following services as part of Work of this Section:

.1 Design of elevator.

.2 Review, stamp, and sign shop drawings and design calculations.

.3 Conduct shop and on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and accepted shop drawings. Perform inspections once a month minimum.

.4 Reports and Certificates: Submit written inspection and test report results within 3 working days after each inspection.

1.8 WARRANTY

.1 Section 01700: Warranties.

.2 Correct defective Work within a one year period after Date of Substantial Completion.

.3 Warranty: Include coverage for elevator operating equipment and devices.

1.9 MAINTENANCE SERVICE

.1 Section 01700: Operation and maintenance.

.2 Provide service and maintenance of elevator system and components during warranty period.

.3 Comply with CSA B44.2 on Maintenance of Elevators, and any other local authority rulings and requirements.

.4 Examine system components, clean, adjust, and lubricate equipment as per planned maintenance tasks and frequencies.

.5 Include systematic examination, adjustment, and lubrication of elevator equipment; maintain hydraulic fluid levels. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment. Replace wire ropes when necessary to maintain the required factor of safety.

.6 Perform work without removing cars during peak traffic periods.

.7 Provide emergency call back service 24 hours for this maintenance period.

.8 Maintain locally, near the Place of the Work, an adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure the fulfilment of this maintenance service, without unreasonable loss of time.

.9 Perform maintenance work using competent and qualified personnel under the supervision of the elevator manufacturer or original installer.

.10 Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Consultant.

1.10 EXTRA MATERIALS

.1 Supply two extra keys, access cards and one lockable key cabinet.

PART 2 Products

2.1 MANUFACTURERS

.1 Delta Elevator Co. Ltd. Model: Delta 9000 LULA.

2.2 MATERIALS

.1 Use major elevator components from standard product line of one manufacturer unless otherwise approved by Consultant.

.2 Use components only which have performed satisfactorily together under conditions of normal use in not less than two other elevator installations of similar design and for a period of at least one year. Furnish names and addresses of Owners or managers of buildings, in which proposed combination of major components has so performed.

.3 Stainless steel sheet and plate: ASTM A167, Type 304, AISI No. 4 finish. Sizes and shapes indicated.

.4 Structural shapes, plates, and similar items: CAN/CSA-G40.20/G40.21-M, Grade 350W.

.5 Hollow structural sections: CAN/CSA-G40.20/G40.21-M, Grade 350W, Class H.

.6 Galvanized sheet steel: ASTM A653/A653M Grade A, Z275 Commercial Quality zinc coating, size and shape as shown.

.7 Fastening devices (exposed): Stainless steel two hole ("snake eyes") dual pin vandal resistant fastenings finished to match adjacent surface. Exposed fastenings shall be countersunk.

.8 Fastening devices (concealed): Unfinished bolts conforming with ASTM A307, Grade A, with hexagon heads and nuts. Supply bolts of lengths required to suit

thickness of material being joined, but not projecting more than 1/4" beyond nut, without the use of washers.

.9 Plywood: CSA O121-M, Select or Select-Tight Face grade, laminated with waterproof adhesive, exterior grade.

.10 Conduits: CSA C22.2 No. 45-M; Rigid steel, hot-dip galvanized, threaded at both ends. Metallic rigid conduit other then hot dip galvanized rigid steel is not acceptable.

.11 Liquid tight flexible metallic conduit: CSA C22.2 No. 56; PVC jacketed, interlocking zinc coated steel spiral strip conduit.

.12 Low voltage wires and cables: CSA C22.2 No. 75; as specified for installation into conduits only, with minimum 600 V insulation.

.13 Hydraulic pipe and fittings: to ASME A17.1/CSA B44.

2.3 ROPED HYDRAULIC SYSTEM

.1 Safety: Provide instantaneous safety which will be actuated by friction governor or slack ropes. Instantaneous safety shall be automatic, and reset by running car in up direction.

.2 Governor: Governor shall be located in hoist way overhead. Governor shall include an electrically activated means of manually tripping governor from machine room for annual no-load and five-year full-load safety tests. Design shall not require a governor access door.

.3 Plunger and Cylinder: Construct cylinder of steel pipe of sufficient thickness and suitable for operating pressure. Top of cylinder shall be equipped with cylinder head and drip ring to collect any oil seepage as well as an internal guide ring and

.4 self-adjusting packing. Plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with fine polished finish. Provide plunger with stop ring electrically welded to prevent plunger from leaving cylinder.

.5 Plunger and cylinder shall be installed plumb and shall operate freely with minimum friction.

.6 Ropes: Minimum two (2) 13/32" aircraft cable

.7 Sheave Carriage: Sheave carriage to be guided along elevator rails. Sheave to be of metal construction and of diameter to suit wire ropes.

2.4 HYDRAULIC EQUIPMENT

.1 Pumping Unit: Pumping unit shall be of integral design and shall include submersible electric motor connected to pump, hydraulic control system, storage tank, necessary piping connections, and controller, all compactly designed as single self-contained unit. Motor and pump assembly shall be mounted on rubber isolated inner base.

.2 Pump: Provide positive displacement screw type pump to give smooth operation and specially designed and manufactured for elevator service.

.3 Motor: Alternating current, submersible design motor for quiet operation.

.4 Control Valve:

.1 Hydraulic control system shall be of compact design suitable for operation under required pressures.

.2 Manual lowering feature shall permit lowering elevator at slow speed in event of power failure.

.5 Storage Tank: Steel tank provided with cover and filter screen mounted over suction inlet. Tank design shall incorporate reserve capacity. Provide initial supply of oil sufficient for proper operation.

.6 Piping: Pipe and/or hose as permitted by code of adequate size and thickness shall be installed between pumping unit and cylinder head. Provide shut off valve for maintenance and adjusting purposes.

2.5 ELECTRICAL EQUIPMENT

.1 Controller: Provide microprocessor controller. Include necessary starting switches of adequate size together with all relays, switches and hardware required to accomplish operation specified. Overload protection shall be provided to protect motor against overloading.

.2 Car Stall Protective Circuit: Provide protective circuit to stop motor and pump and return car to its lowest landing in event car does not reach its designed landing within a predetermined time interval. This circuit will permit a normal exit from car but prevent further operation of elevator until trouble has been corrected.

.3 Wiring: All wiring and electrical interconnections shall comply with governing codes.

.4 Levelling Device: Elevator shall be provided with an automatic levelling device, which will bring car to a stop within 1/4" of landing level regardless of load or direction of travel. Landing level will be maintained within levelling zone irrespective of hoistway doors being open or closed.

.5 Hoistway Operating Devices: All required Hoistway operating switches to be provided.

2.6 PLATFORM AND ENCLOSURE

.1 Platform: Car platform shall be fabricated from structural steel frame (formed or shaped). Sub-flooring shall be wood. Fireproof underside of platform. The platform shall be manufactured by CWB certified shop and be equipped with an aluminum sill.

.2 Car Frame: Fabricate suitable car frame from formed or structural steel members complete with adequate bracing to support platform and car enclosure. Guides to be mounted on top and bottom of car frame to engage guide rails.

.3 Rails: Steel elevator guide rails shall be furnished to guide car, erected plumb and securely fastened to building structure.

.4 Pit Switch: An emergency stop switch shall be located in pit.

.5 Pit Maintenance Stand: Provide non-removable means to mechanically hold car above pit floor to provide an area in pit for maintenance and inspection as per requirements of ASME A17.1/CSA B44.

2.7 DOOR OPERATION

.1 Select one or more of the following subparagraphs appropriate to the equipment requirements.

.2 All operators and buttons to conform to Barrier-Free Standards.

.3 Car Floor Indicator: One (1) digital dot matrix alphanumeric display to be installed in each car as part of car station.

.4 Sound audible soft-toned signal in car when car is passing or stopping at floor.

.5 Braille plates on car station.

.6 Car directional lantern: Located in strike post of each car door.

2.8 OPERATING PANEL AND BUTTONS

.1 All operators and buttons to conform to Barrier-Free Standards.

.2 Car Floor Indicator: One (1) digital dot matrix alphanumeric display to be installed in each car as part of car station.

.3 Sound audible soft-toned signal in car when car is passing or stopping at floor.

.4 Braille plates on car station.

.5 Car directional lantern: Located in strike post of each car door.

.6 Hall position indicator.

.7 Include card reader and key switches for controlled access to basement.

2.9 CAR FABRICATION

.1 Frame: Rigid and braced, rolled or formed steel sections, mounted on resilient isolators.

.2 Platform: Steel frame, with fire retardant treated plywood subflooring assembly, ready to receive floor finish.

2.10 CAB FINISHES

.1 Flooring: Tiled. Refer to dwg.

.2 Walls: Stainless steel binder channel on raised plastic laminated wall panel. Plastic laminate colour to be selected from Manufacturer's standard line.

.3 Front Return Panel: Stainless steel.

.4 Base: Stainless steel, recessed.

.5 Reveals: Stainless Steel.

.6 Ceiling: Stainless steel and emergency access as per CSA B44 Elevator Code.

.7 Light Fixtures: Include 4 recessed LED downlights. Elevator lights shall turn on automatically when the elevator door is opened and stay on while the elevator is in use. The elevator lights will shut off by a timer when the elevator is not in use. Totally enclose and conceal wiring and ballast from view within car and ceiling finish.

.8 Ventilation: Single speed fan above ceiling.

.9 Control Panel and Face Plate: Stainless steel with illuminating call buttons.

.10 Indicator Panel: above control panel with illuminating position indicators.

.11 Hand Rail: Stainless steel flat bar stock placed at all non-entrance walls.

.12 Pad Hooks: Stainless steel type,

.13 Certificate Frame and Glazing: Stainless steel frame, clear tempered glass attached with tamper proof screws. Mounted on elevator cab wall.

2.11 CAB ENTRANCES

.1 Cab Doors: Stainless steel, 0.058 inch thick metal, of insulated sandwich panel construction, flush design, rolled profiles, rigid construction. Fabricate front return panels same as doors.

.2 Cab Door Frames: Stainless steel, 0.058 inch, thick metal, welded corner design with smooth invisible joints].

.3 Thresholds: Extruded aluminum type.

2.12 HOISTWAY ENTRANCES

.1 Hoistway Doors (all floors): Stainless steel, 0.058 inch thick metal, of insulated sandwich panel construction, flush design, rolled profiles, rigid construction.

.2 Door and Frame Construction: 1-1/2 hour fire rating; insulated sandwich panel door construction 1-1/4 inch thick, minimum.

.3 Weatherstripping: Weatherstrip hoistway doors and frames to eliminate audible noise caused by air movement, imposed by car movement in the hoistway, and air pressure differential between hoistway and landing floors.

.4 Sills: Stainless steel.

.5 Sight Guards: sight guards shall be furnished on the leading edge of the doors to conceal the hoistway beyond the doors. Finish to match door panels.

2.13 EMERGENCY LIGHTING

.1 The emergency power unit shall illuminate the elevator car and provide current to the alarm bell in the event of normal power failure. The equipment shall comply with the requirements of the current CSA B44 Elevator Code.

.2 Battery operated emergency lighting equipment, to CSA C22.2No.141, to provide general illumination and 10 lx minimum illumination in car at operating panels and telephone cabinet for 4 h minimum.

.3 Key operated switch for manual testing of unit from within car.

.4 Battery unit of sufficient strength to support 220 lbs person without causing malfunction or damage.

.5 Means to contain leakage or spillage of electrolyte.

2.14 EMERGENCY RECALL SYSTEMS

.1 Upon activation of building fire alarm system, automatically start or return elevator car to main floor level at rated speed. Connect fire alarm signal wires to controller for recall and emergency lighting. Open doors to allow passengers to exit and park car with doors closed.

.2 In event of power failure, provide sealed type emergency batteries in controller to lower car to ground level. Open doors to allow passengers to exit and park car with doors closed.

PART 3 Execution

3.1 EXAMINATION

.1 Verification of existing conditions before starting work.

.2 Verify that hoistway, pit, and machine room are ready for work of this section.

.3 Verify hoistway shaft and openings are of correct size and within tolerance.

.4 Verify location and size of machine foundation and position of machine foundation bolts.

.5 Verify that electrical power is available and of the correct characteristics.

3.2 PREPARATION

.1 Arrange for temporary electrical power for installation work and testing of elevator components.

3.3 INSTALLATION

.1 Install in accordance with CSA B44/B44S1, CSA B44.1, CSA W55.3.

.2 Install system components. Connect equipment to building utilities. Install piping between hoistway plunger and pump unit.

.3 Provide conduit, boxes, wiring, and accessories.

.4 Mount motor and pump unit on vibration and acoustic isolators, on bed plate and concrete pad. Place unit on structural supports and bearing plates. Securely fasten to building supports. Prevent lateral displacement.

.5 Accommodate equipment in space indicated.

.6 Install guide rails using threaded bolts with metal shims and lock washers under nuts. Compensate for expansion and contraction movement of guide rails.

.7 Accurately machine and align guide rails. Form smooth joints with machined splice plates.

.8 Bolt or weld brackets directly to structural steel hoistway framing.

.9 Field Welds: Chip and clean away oxidation and residue, wire brush; spot prime with two coats.

.10 Coordinate installation of hoistway wall construction.

.11 Install hoistway door sills, frames, and headers in hoistway walls. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.

.12 Fill hoistway door frames solid with fire rated assembly.

.13 Adjust equipment for smooth and quiet operation.

3.4 WIRING

.1 Install wiring in accordance with reviewed shop drawings. Tie wrap conductors.

.2 Provide wiring to connect all parts of the elevator equipment including interconnecting wiring running between machine room and elevator hoistway.

.3 Wiring to be stranded or solid, to suit manufacturer's specific requirements. Wiring shall be provided with flame proof and moisture resisting outer cover.

.4 Wrap spare conductors together and labeled with their ends insulated.

.5 Solder or fasten wiring connections to terminal strips or studs using approved mechanical fasteners.

.6 Provide wiring harness where multiplicity of conductors are terminated at remote panel terminal strips.

.7 Clearly identify controller components with designations corresponding to those used on electrical circuit drawings.

.8 Provide insulated bushings around wiring openings where traveling cable and other multi conductor cables are run through openings in car enclosure.

.9 Wiring connections to door detectors shall be protected from chaffing and splitting.

.10 Where liquid tight conduit is used, provide conduit supports and fastenings at intervals of not more than 5 ft.

3.5 FIELD TESTING

.1 During installation, Consultant may carry out periodic Site inspections to gauge progress of the work and assess monthly invoices.

.2 Provide full co-operate with Consultant to allow unrestricted access of the installation, including machine room, hoistway, and car platform.

.3 Perform all tests and inspections as required under ASME A17.1/CSA B44 and Elevating Devices Act.

.4 Include all costs of Provincial registration, design submission and acceptance inspection fees.

.5 Coordinate and schedule with TSSA acceptance inspections.

.6 Performance and operation or commissioning inspections shall be carried out by the Owner's designated representatives and shall be scheduled to take place before TSSA acceptance inspection.

.7 During commissioning inspections, supply sufficient test weights to demonstrate performances under full load and no load conditions.

3.6 EQUIPMENT PERFORMANCE AND ADJUSTING

.1 Adjust elevator to attain the following performance criteria:

- .1 Car movement on guide rails: smooth movement, with no perceptible lateral or oscillating movement or vibration.
- .2 Car speed variation: maximum 5% in lifting rated load.
- .3 Car speed variation: maximum 10% in UP or DOWN speed, empty to full rated load.
- .4 No noticeable shift in acceleration or deceleration rates.
- .5 Car leveling accuracy shall be maintained at +/- 1/4", under all load conditions.
- .6 Guide rail alignment: plumb and parallel to each other within 1/8".

.2 Adjust door opening and closing times to suit handicapped users in accordance with Consultants instructions.

.3 Adjust automatic floor leveling feature at each floor.

3.7 CLEANING

.1 Section 01700: Cleaning installed work.

.2 Remove protective coverings from finished surfaces.

.3 Clean surfaces and components ready for inspection.

3.8 PROTECTION OF FINISHED WORK

.1 Section 01700: Protecting installed work.

.2 Do not permit construction traffic within cab after cleaning.

END OF SECTION

SPADINA MUSEUM GARAGE REHABILITATION AND SITE ACCESSIBILITY

285 SPADINA ROAD, TORONTO, ON

MECHANICAL & ELECTRICAL SPECIFICATIONS

ISSUED FOR RE-TENDER/PERMIT
OCTOBER 20, 2023

PREPARED BY: MAT 4SITE ENGINEERS LTD.
M4SE #: 22626

Section Number	Section Title
Section 21 05 00	COMMON WORK RESULTS FOR MECHANICAL
Section 22 05 15	PLUMBING SPECIALTIES AND ACCESSORIES
Section 22 10 10	PLUMBING PUMPS
Section 22 11 17	DOMESTIC WATER PIPING - COPPER
Section 22 13 16	DRAINAGE WASTE AND VENT PIPING - CAST IRON AND COPPER
Section 22 13 17	DRAINAGE WASTE AND VENT PIPING - PLASTIC
Section 22 42 13	PLUMBING FIXTURES AND TRIM
Section 23 05 01	OPERATING AND MAINTENANCE HVAC SYSTEMS DURING CONSTRUCTION
Section 23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
Section 23 05 17	PIPE WELDING
Section 23 05 19	METERS AND GAUGES FOR HVAC PIPING
Section 23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
Section 23 05 53	MECHANICAL IDENTIFICATION
Section 23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
Section 23 07 13	DUCT INSULATION
Section 23 07 19	PIPING INSULATION
Section 23 08 13	PERFORMANCE VERIFICATION OF MECHANICAL SYSTEMS
Section 23 08 16	CLEANING AND START-UP OF HVAC PIPING SYSTEMS
Section 23 21 14	HYDRONIC SYSTEMS PIPING AND VALVES
Section 23 21 16	HYDRONIC SPECIALTIES
Section 23 21 23	HYDRONIC PUMPS
Section 23 22 13	CONDENSATE PIPING
Section 23 23 00	REFRIGERANT PIPING
Section 23 25 00	HVAC WATER TREATMENT SYSTEMS
Section 23 31 13	METAL DUCTS - LOW PRESSURE TO 1000 PA
Section 23 33 00	AIR DUCT ACCESSORIES
Section 23 33 14	DAMPERS – BALANCING
Section 23 33 16	DAMPERS - FIRE AND SMOKE
Section 23 34 00	HVAC FANS
Section 23 37 13	DIFFUSERS, REGISTERS AND GRILLES
Section 23 52 00	HEATING BOILERS
Section 23 72 00	AIR TO AIR ENERGY RECOVERY EQUIPMENT
Section 23 81 29	VARIABLE REFRIGERANT FLOW HVAC SYSTEMS
Section 26 05 00	COMMON WORK RESULTS FOR ELECTRICAL
Section 26 05 05	MOUNTING HEIGHTS
Section 26 05 10	OPERATION AND MAINTENANCE MANUALS FOR ELECTRICAL
Section 26 05 20	WIRE AND BOX CONNECTORS (0-1000V)
Section 26 05 21	WIRES AND CABLES (0-1000 V)
Section 26 05 22	CONNECTORS AND TERMINATIONS
Section 26 05 28	GROUNDING – SECONDARY
Section 26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
Section 26 05 31	SPLITTERS, JUNCTION, PULL BOXES, AND FITTINGS
Section 26 05 32	OUTLET BOXES, CONDUIT BOXES, AND FITTINGS
Section 26 05 34	CONDUITS, CONDUIT FASTENINGS, AND CONDUIT FITTINGS
Section 26 05 43	CONCRETE ENCASED DUCT BANKS
Section 26 05 73	POWER SYSTEM STUDY
Section 26 05 88	CUTTING AND PATCHING
Section 26 08 00	COMMISSIONING ELECTRICAL
Section 26 09 24	LIGHTING CONTROL DEVICES – LOW VOLTAGE
Section 26 24 01	SERVICE EQUIPMENT
Section 26 24 02	SERVICE ENTRANCE BOARD

Section 26 24 17	PANELBOARDS BREAKER TYPE
Section 26 27 26	WIRING DEVICES
Section 26 28 14	FUSES LOW VOLTAGE
Section 26 28 17	MOLDED CASE CIRCUIT BREAKERS
Section 26 28 20	GROUND FAULT CIRCUIT INTERRUPTERS – CLASS “A”
Section 26 28 23	DISCONNECT SWITCHES – FUSED AND NON-FUSED
Section 26 50 00	LIGHTING
Section 27 00 00	COMMUNICATION SPECIFICATIONS
Section 28 00 00	SECURITY SPECIFICATIONS
Section 28 31 02	FIRE ALARM SYSTEM – MODIFICATION

PART 1 General

1.1 RELATED SECTIONS

.1 Division 1

.2 'Mechanical Divisions'

.1 Division 21

.2 Division 22

.3 Division 23

1.2 GENERAL

.1 This section of the specification is an integral part of the Contract Documents and shall be read accordingly.

.2 The General Conditions of the Contract, the Supplementary Conditions and all Sections of Division 1 - General Requirements shall be deemed to apply and be a part of this section of the specification as fully as if recited in full herein.

.3 Definition

.1 Mechanical Contractor: The term "Mechanical Contractor" is used within this specification when referring to the Division 21, 22 and 23 Contractor.

.4 This Section is specific to the aforementioned Mechanical Divisions and is relevant and applicable in all cases.

.5 All bidders with relevant work under these Mechanical Divisions shall include for all labour, material, equipment and any other related costs to provide a complete and fully operational mechanical system as described and visually represented in the mechanical drawings and Mechanical Division Specifications.

.6 In the event of any doubt from the Mechanical Contractor or their sub-contractors, the consultant must be contacted via written documentation for clarification of doubt. Misinterpretation of Mechanical Division drawings or specifications does not relieve the Mechanical Contractor or their sub-contractors from the responsibility of providing a complete and fully operational mechanical system.

.7 The Mechanical Contractor must examine the site and the local conditions that may affect the work prior to the start of work. All other Division drawings and specifications must be reviewed and understood prior to the commencement of work. If any discrepancies are noted, the Mechanical Contractor must promptly notify the Consultant. No allowance will be made later for any expenses incurred through the failure to make examinations or to report any such discrepancies in writing to the Consultant.

.8 Mechanical Contractor shall provide all tools, scaffolding, materials and storage, site office, etc. as required to complete the work.

1.3 CODES, PERMITS AND FEES

.1 All work shall conform with Federal, Provincial and Local Regulations.

.2 Any ESA, TSSA and/or other Authorities having jurisdiction's permit fees associated with the Mechanical Divisional work shall be payed for by the Mechanical Contractor.

.3 Any equipment that does not bear the required UL/ULC, CSA and/or CETL label will be required to be certified on site by an appropriate 3rd party certification agency. The Mechanical Contractor shall pay for all associated costs of certification.

.4 Provide all inspection and certificates at the completion of work to signify that all work is compliant with the laws and regulations of Authorities having jurisdiction.

1.4 SUSTAINABLE DESIGN

.1 The building or facility shall be designed to meet the following requirements:

.1 The building or facility's Energy Efficiency:

.1 Lower energy consumption, greenhouse gas emissions and peak demand than the NECB prospective reference building.

.2 Equipment Energy Consumption:

.1 All equipment and systems installed to facilitate the intent of the mechanical drawings and specifications shall adhere to the requirements outlined in ASHRAE 90.1 – 2016.

.2 The Consultant has the right to reject any equipment submitted for approval that does not meet the intent or specified basis of performance or energy consumption.

1.5 PREQUALIFIED SUB-CONTRACTORS TO THE MECHANICAL CONTRACTOR

.1 The Mechanical Contractor shall provide all essential test ports and assistance required by the Air and Hydronic Balancing Contractor.

.2 The Mechanical Contractor shall provide all essential assistance required by the Commissioning Contractor and/or Consultant.

.3 Requirements for the TAB/Air and Balancing Sub-Contractors can be found in the Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

.4 Carrying an Alternate Contractor or Alternate Equipment Supplier in the base bid submission will result in the bid being disqualified.

1.6 RELEVANT DIVISION REFERENCES

.1 The following table is provided to assist the Mechanical Contractor in referencing other Divisions that are relevant and applicable to the Mechanical Divisions.

Section Number	Section Title
N/A	Amendments to CCDC 2 - 2008
Section 01 21 00	"Allowances"
Section 01 29 00	"Payment Procedures"
Section 01 31 00	"Project Managing and Coordination"
Section 01 3200	"Construction Progress Documentation"
Section 01 33 00	"Submittal Procedures
Section 01 35 23	"Health and Safety"
Section 01 45 00	"Quality Control"
Section 01 51 00	"Temporary Facilities"
Section 01 52 00	"Construction Facilities"
Section 01 61 00	"Product Requirements"
Section 01 74 00	"Cleaning and Waste Processing"
Section 01 77 00	"Closeout Procedures"
Section 01 78 10	"Closeout Submittals"
Section 03 10 00	"Concrete Formwork"
Section 03 20 00	"Concrete Reinforcement and Accessories"
Section 03 30 00	"Cast in Place Concrete"
Section 07 62 00	"Sheet Metal Flashing and Trim"
Section 07 84 00	"Fire Stopping and Smoke Seals"
Section 07 92 00	"Joint Sealants"
Section 31 23 33	"Excavating Trenching and Backfill"

1.7 CONTRACT AGREEMENT AND UNDERSTANDING

.1 The mechanical drawings and specifications are specific to the aforementioned Mechanical Divisions. Drawings do not show or explain any architectural or structural details, and any specifications involving installation, measurement, material or equipment. Architectural and structural information shall be extracted from their respective Divisional drawings and specifications. Any necessary changes to physical runs of piping, ductwork, tubing, etc. shall be completed to adhere to the aforementioned drawings and specifications.

.2 Structural, Architectural and Electrical drawings and specifications may provide information relevant to the Mechanical Divisions and should be used in conjunction with the mechanical drawings and specifications.

.3 The relocation of any equipment may be done so at no additional charge pending the relocation is altered prior to installation and does not necessitate major additional material and/or labour.

.4 In some cases, there may be differences that occur between floor plans and riser diagrams or schematics and drawings. The Mechanical Contractor shall base their bids on whichever indicates the greater cost.

.5 The Mechanical Contractor must provide field verification and measurements with respect to drawings. Prior to the commencement of any work, the contractor must verify all grade and invert elevations, levels, and dimensions to ensure proper and precise installation. Work completed without field verification is subject to alleviation under the direction of the Consultant at no cost to the Owner.

.6 Any discrepancies found on drawings and/or specifications that differ between drawings or actual field conditions must be brought to the attention of the Consultant immediately for instruction.

.7 All equipment, piping, ductwork, etc. shall be installed in a manner that provide ample service clearances and access. Any interferences with other equipment or material is not acceptable. Access doors shall be provided for all concealed operable mechanical equipment. In the case where the Mechanical Contractor does not abide to these statements, they shall alleviate the issues under the direction of the Consultant at no cost to the Owner.

.8 Further to the work specifically mentioned in the Mechanical Division drawings and specifications, the Mechanical Contractor shall provide all other items, components, service space, etc. that are obviously necessary to complete the installation of work.

.9 If Mechanical Division drawings and/specifications do not provide mounting heights and exact locations of wall mounted equipment, the Mechanical Contractor must obtain approval from the Consultant prior to installation.

.10 The approximate location of terminal devices such as thermostats, humidistats, plumbing fixtures, sprinkler heads, grilles and diffusers etc. located within the finished space are shown on the mechanical drawings. The dimensioned location for these devices is to be obtained from the Architectural drawings. Where these devices are not dimensioned on the Architectural drawings, request the final elevation and location from the Consultants prior to installation. Locate the devices within 1.5 metres of the position shown on the Mechanical Drawings at no cost to the Owner.

1.8 PROGRESS PAYMENTS

.1 The Mechanical Contractor shall submit requests for payment in accordance with Table 1.6.1.

.2 The Mechanical Contractor shall breakdown payment progress draws into identifiable line items as requested by the Mechanical Consultant or Owner. If the Owner does not provide a detailed breakdown list of line items, the contractor can assume the following categories as a rubric:

Line Item	Itemized Description	Sub-Section Breakdowns
Mobilization		
Project Management		
Shop Drawings		
As Built Documentation and Manuals		
Commissioning		
Plumbing and Drainage	Each System (i.e. Sanitary, Storm, Natural Gas, etc.)	- Material - Labour
	Equipment (i.e. Plumbing Fixtures, Valves, Sump Pumps, etc.)	- Material - Labour
Fire Protection	Each System (i.e. Sanitary, Storm, Natural Gas, etc.)	- Material - Labour
	Equipment (i.e. Fire Pump, Jockey Pump, etc.)	- Material - Labour - Start-Up
HVAC	Each System (i.e. HVAC Piping, Sheet Metal, etc.)	- Material - Labour
	Equipment (i.e. Pumps, Air Handling Units, Split Systems, Fan Coil Units, etc.)	- Material - Labour - Start-Up
Process Systems	Each System (i.e. Fuel Oil Piping, Compressed Air Piping, Natural Gas Piping, Laboratory Gas Piping, etc.)	- Material - Labour
	Equipment (i.e. Manifolds, Fuel Oil Pumps, Fuel Tanks, etc.)	- Material - Labour - Start-Up
Controls	Building Automation System Wiring and Conduit	- Material - Labour
	Equipment (Control Panels, Sensors, Integrators, Etc.)	- Material - Labour
	Programming	- Labour

.3 The Consultant shall review the monthly progress draw requests in accordance with the procedures identified in the contract documents.

1.9 FINAL PAYMENT

.1 Final payment to the mechanical contractor will not be released until following test and certificates are submitted to the consultant:

.2 Release of HVAC and P&D permit from the City where the building is being erected.

.3 TSSA certificate/letter of final review and approval for high pressure steam., fuel oil installation, refrigeration piping etc.,

.4 Test certificate approved by the City for all BFPA's installed in the building

.5 Test certificate by the fire protection contractor signed and sealed by a professional engineer confirming design, construction and test in accordance and satisfaction to the City, NFPA 13 and Fire Department,

.6 Video scope result of below grade piping,

.7 Final as-built drawings (soft copy).

.8 Confirmation by the client or minutes of meeting stating training /demonstration sessions have all been completed.

1.10 SUBMITTALS

.1 Submittals: in accordance with Table 1.6.1.

.2 Shop drawings; submit drawings stamped and signed for approval by Owner's Representative.

.3 Shop drawings to show:
- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.4 Shop drawings and product data accompanied by:
- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.5 In addition to transmittal letter referred to in Table 1.6.1.: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.6 Closeout Submittals:
- .1 Provide operation and maintenance data for incorporation into manual specified in Table 1.6.1.
- .2 Operation and maintenance manual approved by, and final copies deposited with, Owner's Representative before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for systems including environmental controls.
  - .2 Description of systems and their controls.
  - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
  - .4 Operation instruction for systems and component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Owner's Representative for approval. Submission of individual data will not be accepted unless directed by Engineer / Architect.

.2 Make changes as required and re-submit as directed by Owner's Representative.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Owner's Representative will provide 1 set of reproducible mechanical drawings or AutoCAD files. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Owner's Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.11 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Table 1.6.1.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Table 1.6.1.

1.12 MAINTENANCE

.1 Furnish spare parts in accordance with Table 1.6.1. as follows:

- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One head gasket set for each heat exchanger.
- .4 One glass for each gauge glass.
- .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Table 1.6.1.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

.4 Provide any and all additional equipment or components as identified in their respective Divisional specifications.

1.13 INSTALLATION OF WORK

.1 It is the responsibility of the Mechanical Contractor to ensure that all Installation of Work is completed in a respectable and professional manner. The Mechanical Contractor shall be responsible for the following:

- .1 The protection and maintenance of all work completed.
- .2 The condition of all material and equipment.
- .3 Workmanship.
- .4 The protection of finished and unfinished work and equipment from other Divisions work. No damage due to other Divisions shall be acceptable.
- .5 Coordinate all work with other Divisions.
- .6 Prompt installation of work prior to concrete pouring or similar work (i.e. unground services and piping, etc.).
- .7 Provide necessary temporary and/or future connections and rough-ins as required to allow for a streamlined work approach. Proceed with work as quickly as practical so that construction may be completed as swiftly as possible in accordance to the construction schedule (refer to table 1.6.1.).
- .8 Ensure that all equipment and materials is delivered to site to accommodate the construction schedule (refer to Table 1.6.1.). If deliveries are on site prior to the possibility of installation or placement, all equipment and material must be securely and safely stored as to not be susceptible to exterior environmental extremities.
- .9 All equipment shall be installed strictly as per manufacturer's instructions and recommendations unless otherwise noted by the Consultant.

1.14 INTERFERENCE DRAWINGS

.1 The Mechanical Contractor shall provide information and locations for the preparation of interference drawings.

.2 Interference drawings shall be prepared in ACAD 2018. If drawings are prepared in Revit, they must be regularly updated and provided to the Consultant for review.

.3 Interference drawings shall be submitted to the Consultant for review in both hard copy (size to match indicated drawing size and scale) and electronic copy (i.e. PDF).

.4 If specific congested areas require interference drawings, the Mechanical Contractor shall inquire with the Consultant on an appropriate drawing viewing scale (specifically for ACAD).

.5 Interference drawings should always be provided in areas where there may be potential conflict of mechanical and electrical installation (i.e. piping, ductwork, cable trays, etc.).

.6 All interference drawings must be coordinated with all other Divisions to ensure accuracy and acknowledgement. Any installation that must be modified to suit interference drawings shall be done so at no cost to the Owner.

.7 Any installation that is completed without the use or submission of interreference drawings will be subjected to revision to adhere to interference requirements at no cost to the Owner.

.8 The Mechanical Contactor must provide interference drawings for any alternative equipment that is approved by the Consultant and does not adhere to the original specified equipment dimensions.

.9 Installation of work shall not commence until approval of interference drawings is completed by the Consultant.

.10 In the event that there is interferences between multiple Divisions, an on site work meeting shall be organized by the Mechanical Contractor for prompt remedial action to take place.

1.15 MATERIALS

.1 All materials shall be in accordance with the Mechanical Division drawings and specifications. In the event that the Mechanical Contractor wishes to provide an alternative, equivalent and/or substitute, the following criteria must be followed:

- .1 The Mechanical Contractor shall provide itemized cost savings.
- .2 The Consultant has the ability to reject submissions and request samples from the Mechanical Contractor.
- .3 The Mechanical Contractor must bear any and all additional costs associated with requirement of 3rd party certified testing agencies to evaluate the quality of materials and equipment to be installed.

.2 The basis of bid is based on manufacturer, brand name, performance, type and/or serial number provided in the Mechanical Division drawings and specifications. Materials and equipment specified shall be used as part of this work, unless mutual acceptance is provided in writing between the Mechanical Contractor and the Consultant.

1.16 SHOP DRAWINGS

.1 The Mechanical Contractor must submit detailed performance, dimensional and installation piping and wiring diagrams for the mechanical equipment part of this work.

.2 All shop drawing documentation shall be sent in electronic format (i.e. PDF). Each submission shall include a front-page transmittal indicating date of submission, Mechanical Contractor information, project title and address, Owner and Consultants project number, project managers names and titles (both Owner and Consultant) and review stamp by Mechanical Contractor.

.3 The Consultant shall provide a stamped electronic copy of the shop drawing documents. It is the Mechanical Contractors responsibility to review comments and resubmit shop drawings as required.

.4 The Mechanical Contractor shall ensure that a minimum of one (1) hard copy of each reviewed shop drawing is provided on site for reference.

1.17 CONSULTANT'S INSTRUCTIONS

.1 At any given time during the course of construction, the Consultant may provide instructions as deemed necessary for verification and/or correction to the work. All instruction shall be provided in written documentation and shall effectively become a binding agreement as part of the drawings and/or specifications.

1.18 WARRANTY

.1 All work and installed equipment shall be provided with a warranty against all defects in workmanship and material for a period of one (1) year after the substantial completion date of the work. The substantial completion date must be documented in written format.

.2 Equipment warranties are indicated in their respective Divisional specification sections.

1.19 EQUIPMENT

.1 All equipment shall be installed in such a way to permit accessibility for maintenance.

.2 All equipment shall be installed with unions, flanges or other means to allow for ease of replacement and to minimize disturbance to mechanical systems.

.3 All equipment shall be installed as to not interfere with building structure or other mechanical equipment.

.4 All equipment drain ports must be piped to nearest floor drain. For glycol systems, pipe to nearest glycol feeder tank. In no case will drain ports not piped to a drain be accepted.

.5 All equipment must be installed with the proper support (i.e. saddles, platforms, hangers, etc.) as deemed necessary by Structural, Mechanical Division specifications and manufacturer's requirements.

1.20 REVIEW OF INSTALLATIONS

.1 No workmanship and equipment that is to be concealed shall be insulated or finished without Consultant review and approval prior to completion. The Mechanical Contractor shall arrange for Consultant site visits based on the construction schedule and inform the Mechanical Consultant when tests are deemed to take place.

.2 The Mechanical Contractor shall bear all costs associated with retesting and making good as deemed necessary by the Consultant due to failure of adhering to statement 1.19.1.

.3 Prior to any testing of hydronic or air systems, the Mechanical Contractor shall isolate all equipment and any other systems that are not designed to withstand test pressures. The Mechanical Contractor must also ensure any capped ductwork or valves are rated at a 'dead end' operational pressure rating larger than test pressure.

1.21 PAINTING FOR MECHANICAL

.1 All gas lines shall be painted in their entirety with a yellow exterior rated paint as per CSA B149. Any gas lines located within ceiling spaces above T-bar, drywall or similar partition materials shall be banded in accordance with Canadian Gas Authority requirements.

.2 Provide flat black painting behind any grilles and diffusers.

.3 During construction, the Mechanical Contractor must identify any and all scuffs and damages that must be repainted and touched up to match the original finish in quality and appearance. The Consultant may request the Mechanical Contractor "make-good" any areas which they deem unfit.

.4 Apply a minimum of one (1) coat of corrosion resistant paint to supports, hangers and equipment fabricated of ferrous materials and subjected to oxidation.

1.22 FLASHING

.1 The Mechanical Contractor shall coordinate all requirements for roofing, water-proofing and flashing with other Divisions.

.2 All mechanical equipment and supports passing through or built into a roof shall be provided with flashing as directed by the roofing trade. All flashing must be installed to ensure a watertight seal.

.3 Fit counter flashing over flashing or equipment curb. All counter flashing must be installed to ensure a watertight seal.

1.23 CURBS AND SLEEPERS

.1 All mechanical equipment to be installed on roofs or outdoors shall be provided with a prefabricated curb. In some cases, built-up curbs and sleepers may be requested but shall be supplied and installed by other Divisions.

.2 If the Mechanical Contractor must supply and install built-up curbs or sleepers, the following guidelines shall be adhered to:

.1 It will be the responsibility of the Mechanical Contractor to supply detailed requirements for curbs. This includes location of curbs, size, weight and materials to be used.

.2 Curbs shall be a minimum of 14" (350 mm) above the finished height of the roof or concrete housekeeping pad.

.3 Curbs must be installed were ductwork and/or piping is penetrating the roof directly below the equipment.

.4 All spaces between curbs, pipes and ducts shall be filled with fiberglass insulative material. Spaces shall be caulked with a weatherproof and fire-resistant compound making a watertight connection.

.5 Any equipment installed outdoors without a curb shall be installed on sleepers. They shall be constructed of pressure treated lumber and be covered by 18-gauge steel cladding, primed and painted unless otherwise noted.

1.24 CUTTING AND PATCHING

.1 Any cutting and patching work required for Mechanical Division equipment and material installation shall be done so after approval from the Architect. The Mechanical Contractor shall provide detailed location and dimensional drawings for approval prior to the commencement of any work.

.2 All cutting and patching shall be governed by Division 1 and Architectural drawings and specification. In the case that there are no Architectural drawings and/or specifications provided, the Mechanical Contractor shall adhere to the following requirements:

.1 All cutting and patching work shall be completed by a specialized trade in the materials to be cut. Cutting and patching drawings or details shall be created by the Mechanical Contractor and submitted to the Consultant for review and approval prior to the commencement of work.

.2 In no case shall any load bearing or structural walls and supports be cut unless written acceptance is provided by a certified Structural Engineer.

.3 Any supporting membranes, walls or structure that is required to be cut must by approved by the Consultant prior to the commencement of work. The Mechanical Contractor shall provide detailed location and dimensional drawings to indicated cuts.

1.25 EXCAVATION AND BACKFILL FOR MECHANICAL

.1 Any excavation and backfill shall be completed as per the appropriate Divisional drawings and specifications. In the case where there is no Divisional drawings or specifications, the Mechanical Contractor shall adhere to the following requirements:

.1 All below grade pipe shall be installed with grading of the bottom of the pipe excavation trench.

.2 All below grade pipes shall be installed directly on soil where soil is firm and undistributed. The soil shall be shaped to fit the lower one-third segment of all pipes and pipe bells. Excess excavation shall be backfilled with 3625 psi (25 mPa) concrete.

.3 All below grade pipes installed on unstable soil, in fill and where previous bedding had been removed at an earlier time (especially in close proximity to perimeter building walls, man holes and catch basins) shall be done so with new bedding below the pipe. Bedding to be compacted to a maximum possible density and pipes shall be supported by a minimum 8" (200 mm) thick firm support. Install reinforcing steel in cradle or construct piers every 8 feet or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use same method where pipes cross.

.4 Where excavation is necessary in proximity to and below the level of any footing, backfill with 3625 psi (25 mPa) concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the consultant.

.5 Provide support over at least the bottom one third segment of the pipe in all bedding methods.

.6 Do not open trench ahead of pipe laying and backfilling more than weather will permit. Keep walls of trenches straight to at least 18" (450 mm) above the top of the pipe to keep the diameter load within the pipe design limits. Have excavations inspected at least once a week by authorities.

.7 Before backfilling, obtain approval. Remove all shoring during backfill.

.8 Backfill trenches within building, with clean sharp sand or gravel in individual layers of maximum 6" (150 mm) thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 12" (300 mm) above the top of pipe. Hand or machine compact the balance up to grade, using approved equipment.

.9 Backfill trenches outside buildings, not under roads, parking lots, or traffic areas, up to a compacted level of 18" (450 mm) above the pipes with individual layers of material 6" (150 mm) thick, hand compacted to a density of 95% Standard Proctor, using approved 3/8" (10 mm) crushed stone. Backfill the balance with 6" (150 mm) layers of approved excavated material, compacted to 95% Standard Proctor, using approved equipment.

.10 Backfill all other trenches outside buildings with 6" (150 mm) 3/8" crushed stone in layers not exceeding 6" (150 mm) thickness, compacted to 100% Standard Proctor density up to grade level. Manual compaction up to 18" (450 mm) above the pipe with approved equipment for the balance.

.11 Fill all depressions to a correct grade level with appropriate material. After a period has passed adequate to reveal any settlement, use maximum possible compaction. Pay all costs required to make good all damages caused by settlement.

.12 All excavated materials shall be removed from site.

1.26 MECHANICAL AND ELECTRICAL COORDINATION

.1 The following is a table of mechanical and electrical responsibilities for the work to be completed.

Item	Provided By	
	Mechanical (Divisions 21, 22, 23 and 25)	**Division 26**
Motor Control Centres, Switchboards, etc.		X
Remote Disconnect Switches complete with fuses when required		X
Motors	X	
Fire Alarm Work		X
Life Safety Control Wiring and Relays		X
Wiring to Sprinkler Pressure Switches, Supervisory Valves, Flow Switches, Dry Pipe Alarm Valves, etc.		X
Stand-By Generators (Including Equipment Specification and Accessories)		X
Ventilation and Fuels Systems for Generators	X	
Power Wiring to Heat Tracing		X
Electrical Connections for Trap Seal Primer Manifolds, Softeners, Faucets	X	
Wiring of Level Switches for Sump Pumps	X	
Wiring and conduit for Voltages below 120 V	X	
Wiring and conduit for Voltages 120 V and above		X
Variable Frequency Drives	X	

.3 All motor control centers, switchboards, motors at 120 V and above, etc., along with input and output power wiring will be by Division 26 unless Mechanical equipment is shipped to site as a packaged solution with a single power feed and includes internal transformers and starters. Refer to individual specification sections to identify equipment that is to be provided with single power feeds.

.4 All starters shall be supplied by Mechanical Divisions. Installation and wiring of starters by Division 26 for any line and load side voltages of 120 V and above. Otherwise, by Mechanical Divisions.

.5 Packaged equipment will have integral starters and only power feeders need be provided by Division 26.

.6 Provide fire rated plywood backboards whenever communication equipment is to be wall mounted. Plywood is to be 21mm thick. Plywood to be either fire rated or with the appropriate label or coated with fire retardant paint.

.7 If no wall location is suitable for mounting motor starters or VFD's, then mount the equipment on plywood backboard on Unistrut supports to meet the applicable code requirements for motor isolation switches.

PART 2 Products

2.1 SLEEVES

.1 Shall be a minimum 22-gauge (0.8 mm) thick galvanized steel with lock seam joints at partition walls.

.2 Use cast iron sleeve or steel pipe sleeves with annular fin continuously welded at midpoint. PVC sleeves with annular fin are also acceptable as follows:

.1 Through foundation walls.

.2 Where sleeves are specified to extends above finished floor.

.3 Sizes

.1 1/4" (6 mm) clearance all around, between sleeve and pipes or between sleeve and insulation.

.4 Where piping passes below footings, provide minimum clearance of 2" (50 mm) between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing.

.5 Terminate sleeves flush with surface of concrete and masonry and 4" (100 mm) above floors. Not applicable to concrete floors on grade.

.6 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water tight durable joint.

.7 Fill voids around pipes.

.8 For sleeves and pipe in foundation walls and below grade floors, provide "link seal" clamp.

.9 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe (duct) and sleeve with waterproof fire retardant non hardening mastic. Seal space at each end of sleeve with waterproof, fire retardant, non hardening mastic.

.10 Ensure no contact between copper tube or pipe and ferrous sleeve.

.11 Fill future use sleeves with easily removable fire stop filler.

.12 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

.13 Where pipes and ducts pass through fire rated walls, floors and partitions, pack space with fire stopping materials as specified in Section 07 84 00 “Fire Stopping”

.14 Install sleeves following approval of interference drawings.

.15 On typical floors, provide one diameter between adjacent sleeves.

.16 Extend sleeves 6" (150 mm) above floors in mechanical rooms and all areas where waterproofing is required.

.17 All sleeves shall be as detailed on drawings.

.18 All sleeve locations including dimensions shall be submitted to the Structural Engineer for review.

.19 All sleeved or formed openings through the structure must be shown on sleeving drawings which are submitted to all Consultants for review prior to Construction. No holes through the structure will be permitted without written approval of the Architect.

.20 The Mechanical Contractor shall be responsible for showing all sleeve locations required by the Mechanical Sub Contractors on the interference drawings.

.21 The Mechanical Contractor shall be responsible for installing all of the sleeves required for the Mechanical contract and the Mechanical Sub Contractors.

.22 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water tight durable joint.

.23 For sleeves and pipe in foundation walls and below grade floors, provide link seal clamp.

.24 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

2.2 ESCUTCHEONS AND PLATES

.1 Use chrome or nickel-plated brass, solid type with set screws for ceiling or wall mounting. All escutcheons and plates in exhibition spaces shall be flat black.

PART 3 Execution

3.1 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.2 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Table 1.6.1. and submit report as described in SUBMITTALS.

.1 Submit tests as specified in other sections of this specification.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in QUALITY ASSURANCE.

3.3 DEMONSTRATION

.1 Owner’s Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Owner’s Representative may record these demonstrations on video tape for future reference.

3.4 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system

3.5 SLEEVES

.1 Where piping passes below footings, provide minimum clearance of 2" (50 mm) between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing.

.2 Terminate sleeves flush with surface of concrete and masonry and 4" (100 mm) above floors. Not applicable to concrete floors on grade.

.3 Fill voids around pipes.

.4 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe (duct) and sleeve with waterproof fire retardant non hardening mastic. Seal space at each end of sleeve with waterproof, fire retardant, non hardening mastic.

.5 Ensure no contact between copper tube or pipe and ferrous sleeve.

.6 Fill future use sleeves with easily removable fire stop filler.

.7 Where pipes and ducts pass through fire rated walls, floors and partitions, pack space with fire stopping materials as specified in Section 07 84 00 “Fire Stopping”.

.8 Install sleeves following approval of interference drawings.

.9 On typical floors, provide one diameter between adjacent sleeves.

.10 Extend sleeves 6" (150 mm) above floors in mechanical rooms and all areas where waterproofing is required.

.11 All sleeves shall be as detailed on drawings.

.12 All sleeve locations including dimensions shall be submitted to the Structural Engineer for review.

.13 All sleeved or formed openings through the structure must be shown on sleeving drawings which are submitted to all Consultants for review prior to Construction. No holes through the structure will be permitted without written approval of the Architect.

.14 The Mechanical Contractor shall be responsible for showing all sleeve locations on the interference drawings.

.15 The Mechanical Contractor shall be responsible for installing all of the sleeves.

3.6 ESCUTCHEONS AND PLATES

.1 Provide on pipes passing through finished walls, partitions, floors and ceilings.

.2 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.

.3 Where sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

.4 Secure to pipe or finished surface but not to insulation.

3.7 DIELECTRIC COUPLINGS

.1 Provide wherever pipes of dissimilar metals are joined complete with rubber gaskets to prevent contact.

.2 Cast brass adapters may be used on domestic water systems where approved by the Consultant.

.3 Insulating unions to be provided for all pipes NPS 2" and below. Pipes larger to be provided with flanges.

3.8 PIPEWORK INSTALLATION

.1 Installation by certified journeyperson.

.2 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.

.3 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions.

.1 Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.

.2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

.4 Protect openings against entry of foreign material.

.5 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.6 Assemble piping using fittings manufactured to ANSI standards.

.7 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.8 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.9 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.10 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.11 Install, except where indicated, to permit separate thermal insulation of each pipe.

.12 Group piping wherever possible and as indicated.

.13 Ream pipes, remove scale and other foreign material before assembly.

.14 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.15 Provide for thermal expansion as indicated.

.16 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless otherwise indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves and for modulating control.

.6 Use ball or butterfly or gate valves at branch take-offs for isolating purposes except where otherwise specified.

.7 Install butterfly valves on chilled water, condenser water and low temperature heating systems only.

.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.

.9 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.17 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.9 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.1 Unions are not required in installations using grooved mechanical couplings (The couplings shall serve as unions).

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

.4 The flexible type grooved joint couplings may be used only when approved by the consultant in lieu of a flexible connector at equipment connections for

vibration attenuation and stress relief. Couplings shall be placed in close proximity to the source of the vibration, as per manufacturer's recommendations.

3.10 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.11 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.12 AIR VENTS

.1 Install automatic air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.13 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 – Fire Stopping and Smoke Seals.

.2 Uninsulated unheated pipes not subject to movement: No special preparation.

.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation or install per manufacturer's recommendation as specified within the associated approval.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.14 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 – Cleaning and Waste Processing supplemented as specified in relevant sections of other Divisions.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.15 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Owner's Representative, 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections of other sections or Divisions.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of other Divisions.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Owner's Representative. Work to be carried out in off hours after 5 p.m., weekends or holidays.

.6 Pay costs for repairs or replacement, retesting, and making good. Owner's Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Owner's Representative.

3.16 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Owner's Representative. Work to be carried out off hours after 5 p.m., weekends or holidays.

.2 Request written approval ten (10) working days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing specialties and accessories.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 23– Health and Safety Requirements.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 74 00 – Cleaning and Waste Processing

.5 Section 01 78 10 – Closeout Submittals.

.6 Section 21 05 00 – Common Work Results for Mechanical

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA)

.1 AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.

.2 AWWA C701, Cold Water Meters-Turbine Type for Customer Service.

.3 AWWA C702, Cold Water Meters-Compound Type.

.3 American National Standards Institute (ANSI)

.1 ANSI Z358.1 Emergency eyewash and shower equipment.

.4 Canadian Standards Association (CSA)

.1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.

.2 CSA B125.3, Plumbing Products and Materials

.3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.5 Health Canada/Workplace Hazardous Materials Information Systems (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.6 Plumbing and Drainage Institute (PDI)

.1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201, Water Hammer Arresters Standard.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.

.2 Indicate dimensions, construction details and materials for specified items.

.3 Submit WHMIS MSDS in accordance with Section 02 62 00.01 – Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Shop Drawings:

.1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals. Include:

.1 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging materials in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative.

.5 Fold up metal and plastic banding flatten and place in designated area for recycling.

1.6 WARRANTY

.1 Provide a written guarantee, signed and issued in the name of the owner, against defective materials and workmanship for a period of one (1) year from the date of Substantial Completion.

PART 2 Products

2.1 Floor Drains

.1 All floor drains shall be provided with a trap primer tapping

.2 Floor Drains

.1 Stainless steel body with reversible clamp device and adjustable 7" diameter (175 mm) vandal proof stainless steel grate complete with 6" stainless steel funnel and stainless steel secondary sediment bucket, 4" (100 mm) throat on strainer. Provide trap primer connection.

.2 Standard of Acceptance: JR Smith 9700/9703, Zurn, Watts

2.2 Cleanouts

.1 Line Cleanouts

.1 Line cleanouts in cast iron pipe with polyurethane gasketted cover secured to body with full size pipe opening.

.2 Standard of Acceptance: JR Smith 4420, Zurn, Watts CO-200-50

.2 Stack Cleanout

.1 In base of cast iron stacks with neoprene gasketted secured cover. Where cleanouts are concealed behind finished walls access shall be round stainless steel plate and slotted flat head S.S. screws.

.2 Standard of Acceptance: JR Smith 4510, Zurn, Watts CO-460-50

.3 Floor Cleanouts

.1 In Unfinished Areas.

.1 Epoxy coated cast body with integral clamp device, and removable positive seal cleanout plug and heavy duty 6" (150 mm) adjustable cover secured with stainless steel screws.

.2 Standard of Acceptance: JR Smith 4220, Zurn ZN 1600, Wade, Josam, Watts C-100-C-RX-4

.2 In Finished Areas

.1 All cleanouts shall be coordinated with the Architectural floor finish. Submit shop drawing showing all floor cleanouts on Architectural Terrazzo Finish Drawing to coordinate location with Architectural Terrazzo prior to installation.

.3 In GMP production areas:

.1 Same as above with square 304 stainless steel solid cover secured with stainless steel screws and frame recessed. Cover shall be adjustable to suit floor lines when installing finished floor.

.2 Standard of Acceptance: JR Smith 4140 (stainless steel solid cover), Zurn, Watts

.4 In GMP production terazzo areas:

.1 Same as above with round 304 stainless steel solid cover secured with stainless steel screws and frame recessed for terazzo. Cover shall be adjustable to suit floor lines when installing finished floor.

.2 Standard of Acceptance: JR Smith 4180 (stainless steel solid cover), Zurn, Watts

.5 In other finished areas:

.1 Same as above with nickel bronze frame and cover secured with stainless steel screws. Cover shall be adjustable to suit floor lines when installing finished floor.

.2 Standard of Acceptance: JR Smith 4020, Zurn,Watts CO-100-C-R-1

.6 In heavy traffic areas

.1 Same as above with extra heavy nickel bronze frame and cover secured with stainless steel screws. Cover shall be adjustable to suit floor lines when installing finished floor.

.2 Standard of Acceptance: JR Smith 4100, Zurn, Watts CO-C-RX-1

2.3 WATER HAMMER ARRESTOR

.1 Brass piston in a type K copper casing size according to manufacturers recommendation chart below to eliminate water hammer and shock from piping system. Provide water hammer arrester on hot and cold water supplies to all quick valves, solenoids and plumbing fixtures and locate in an upright position between the last two fixtures on a line, or horizontally at the end of line closets to supply source.

SIZE	FIXTURE UNITS	MODEL NO.	CONN. SIZE
A	1-11	SC-500	□" (12 mm)
B	12-32	SC-700	3/4" (20 mm)
C	33-60	SC-1000	1" (25 mm)
D	61-113	SC-1250	1-1/4" (32 mm)
E	114-154	SC-1500	1-1/2" (38 mm)
F	155-330	SC-2000	2" (50 mm)

.2 Standard of Acceptance: PPP Series SC, Watts SG Series, Zurn-1705

2.4 BACK FLOW PREVENTERS

.1 Reduce Principal Back Flow Preventers

.1 Protect entire potable water distribution system against contamination due to back flow from non potable sources. Back flow preventer reduced pressure principle type: to CSA B64.10.

.2 The back flow preventer assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs.

.3 Back siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel.

.4 The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.

.5 Standard of Acceptance for 4" and larger: Watts 909 series, Hersey 6CM Series, Conbraco, Zurn.

.6 Standard of Acceptance for less than 4": Watts 009 series, Hersey, Conbraco, Zurn

.2 Dual Check Valves

.1 Provide dual check valves in the locations shown on the drawings.

.2 The dual check backflow preventer shall meet the domestic requirements of CSA B64.10 and bear the seal of approval.

.3 It shall be bronze-bodied and include not less than one union, with the union nut drilled to accept a tamper-proofing lock wire. A brass identification tag indicating direction of flow shall be securely attached to the valve body by corrosion-resistant mechanical fasteners.

.4 Temperature Range: 33˚F – 180˚F (0.5˚C-82˚C) continuous

.5 Maximum Working Pressure: 150psi (10.3 bar)

.6 Standard of Acceptance: Watts Series 7, Hersey, Conbraco, Zurn.

2.5 TRAP SEAL PRIMERS

.1 Provide for all floor and hub drains.

.2 1 or 2 Floor Drains:

.1 1/2" (12 mm) NPT connections, with strainer and integral back flow preventer and vacuum breaker.

.2 Provide NPS 1/2 Type K hard copper or plastic tubing connection between trap primer valve and floor drain.

.3 Trap primer to be mounted 1 foot above the floor for every 20 feet of make-up water line.

.4 Standard of Acceptance: PPP Model PO-500 as required, Zurn 1022

.3 All Locations with 2 or More traps within 100 feet of each other:

.1 The unit shall supply a minimum of 10 oz. Of water per opening, once in each 24-hour period based on system pressure of 60 psi. Factory assembled with a bronze body ball valve, water hammer arrester, solenoid valve, atmospheric vacuum breaker, 24 hour timer, 3/4" NPT connection, and a type L copper manifold. Electronic single point power connection 120 V 1 amp draw and manual override switch

.2 Trap primer shall be mounted 1 foot above the floor for every 20 feet of make-up water line.

.3 Standard of Acceptance: PPP PT-4 through 24 as required.

2.6 STRAINERS

.1 All strainers to be 125 psi (860 kPa) gauge pressure Y type strainer with 3/4" (20 mesh), bronze or stainless steel removable screen.

.2 2" (50 mm) nominal and under

.1 Bronze, and screwed with brass cap.

.2 Standard of Acceptance: Sarco BT, Armstrong F4SC, Crane 988 2, Braukmann FY32, Leitch BE, Toyo 380, Mueller 351M.

.3 2 1/2" (65 mm) nominal and over

.1 Cast iron, flanged with bolted cap.

.2 Standard of Acceptance: Sarco BF 150, Crane 989 1/2, Armstrong F4FL, Braukmann FH33, Leitch 528 pipeline basket type, Mueller 758

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada, and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

.1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm above finished grade unless otherwise indicated.

3.5 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.6 BACK FLOW PREVENTORS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.1 Reduced pressure type where backflow would constitute a health hazard.

.2 Double check type where backflow would constitute a nuisance or be aesthetically objectionable or material which would not constitute a health hazard.

.2 Pipe discharge to terminate over nearest drain and or service sink.

.3 Test and Certificates:

.1 Mechanical Contractor shall be responsible to test back flow preventers, and any other plumbing equipment and provide certificate as required by local building authority. Cost associated with testing and certification shall be paid by the mechanical contractor.

3.7 BACKWATER VALVES

.1 Install in main sewer lines where indicated.

.2 Install in access pit as indicated.

3.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Owner's Representative.

.3 Install Type K soft copper tubing to floor drain.

3.10 STRAINERS

.1 Install with sufficient room to remove basket.

3.11 GREASE INTERCEPTORS

.1 Install with sufficient space, as indicated, for ease of maintenance.

3.12 TESTING AND ADJUSTING

.1 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.2 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.3 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.4 Floor drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removal accessibility of strainer.

.5 Clean out baskets.

.5 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.6 Roof drains:

.1 Check location at low points in roof.

.2 Check security, removal accessibility of dome.

.3 Adjust weirs to suit actual roof slopes, meet requirements of design.

.4 Clean out sumps.

.5 Verify provisions for movement of roof systems.

.7 Access doors:

.1 Verify size and location relative to items to be accessed.

.8 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.9 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.10 Wall, Ground hydrants:

.1 Verify complete drainage, freeze protection.

.2 Verify operation of vacuum breakers.

.11 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.12 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.13 Grease interceptors:

.1 Activate, using manufacturer's recommended procedures and materials.

.14 Hose bibbs, sediment faucets:

.1 Verify operation and at all low points.

.15 Hydronic system water Make-up Assembly:

.1 Verify operation.

.16 Tempered water assemblies:

.1 Verify operation of Hi/Lo tempered water assemblies at both high and low flow conditions.

.2 Verify proper discharge temperature setpoint for all tempered water assemblies including those serving emergency fixtures.

.17 Training:

.1 Demonstrate full compliance with Design Criteria.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section includes:
- .1 Materials and installation for plumbing pumps.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 23 – Health and Safety.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 74 00 – Cleaning and Waste Processing

.5 Section 01 78 10 – Closeout Submittals.

1.3 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS)

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .2 Submit WHMIS MSDS in accordance with Section 02 62 00.01 – Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Shop Drawings:
- .1 Submit shop drawings to indicate:
  - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
  - .2 Wiring and schematic diagrams.
  - .3 Dimensions and recommended installation.
  - .4 Pump performance and efficiency curves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 – Closeout submittals, include:

.1 Manufacturers name, type, model year, capacity and serial number.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list with names and addresses.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23– Health and Safety.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative.

.5 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.6 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.7 CAPACITY

.1 Capacity for all pumps shall be as indicated on the Mechanical Schedules.

PART 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: see pump schedule.

.2 Construction: closed-coupled, in-line centrifugal, all bronze or stainless steel, construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 860 kPa and 105C continuous service.

.3 Motor: drip proof, with thermal overload protection.

.4 Supports: provide as recommended by manufacturer.

.5 Standard of Acceptance: Bell & Gossett, Armstrong, Taco, Flowfab.

2.2 SUMP PUMP SUBMERSIBLE

.1 Pump Mounting Arrangement

.1 Hydraulic sealing flange: A hydraulically operated sealing flange, complete with Buna N rubber diaphragm type sealing gasket, shall be mounted on each pump discharge. The diaphragm shall be held in place by a 300 series stainless steel ring with stainless steel fasteners.

.2 When the pump is activated, the resulting discharge pressure shall force the diaphragm seal against the flange face of the discharge elbow providing a leak proof seal. When pressure is removed, the diaphragm shall relax so that there is no mechanical connection to the discharge, and pump with hydraulic sealing flange may be easily removed. Units utilizing metal to metal connection which could corrode together shall not be acceptable.

.3 Guide Rail: The guide rails used to direct the pump in proper alignment with the stationary discharge piping shall be of a dual ail design. The rail shall be a 50mm (2") corrosion resistant pipe and positioned on the centerline of the pump to each side so that no weight of the pump bears on either of the two guide rails at any time. The guide rails shall serve truly as a guide rail. Units which do not have the guide rails positioned on the centerline of the pump with off centered weight distribution shall not be considered.

.4 Carrier Guide Bracket: A sliding guide bracket shall be attached to the pump. The sliding carrier guide bracket shall be fabricated from steel and protected with a corrosion resistant coating. The carrier shall be mounted on the pump so lifting is done from the carrier and no strain is placed on the pump or guide rails. Fasteners shall be 300 Series stainless steel. The carrier shall be designed to lift from a centered loop.

.5 Discharge Base Elbow With Base Plate: A discharge elbow shall be furnished for each pump. The discharge base elbow shall be attached to a flat steel fabricated base plate which rests squarely on the wet well floor. The flat base plate shall assure the pump has a smooth surface on which to rest when lowered into position. The base plate shall include a leveling bolt adjustment as well as adjustable guide rail supports which hold the guide rail pipes at the bottom. The pump discharge with

hydraulic sealing flange shall align with the base elbow of the base plate assembly. The sealing face of the base discharge elbow shall be smooth and shall be heavily coated with zing to provide a smooth corrosion resistant and abrasion resistant surface. All fasteners shall be 300 series stainless steel.

.6 When the pump is lowered into place, it shall rest squarely on the base plate, supported only by the feet on the pump. Units which hang from the discharge elbow shall not be acceptable as undue stress may occur on the volute case casing of the pump or on the base elbow of the base plate assembly.

.7 Lift Chain: Each pumps shall be provided with a galvanized lifting chain or cable. The lifting chain or cable shall be of sufficient length to extend from the pumping unit at one end to the top of the wet well at the other end. The access frame shall provide a hook to attach the lifting chain or cable when not in use. The lifting chain or cable shall be sized according to the pumps weight. Provide appropriate chain hooks to permit lifting of pump from well for inspection and service.

.2 Fibreglass Sump Pits

.1 The resins used shall be a commercial grade polyester and shall be evaluated as a laminate by test or determined by previous service to be acceptable for the intended environment.

.2 The reinforcing material shall be a commercial grade of glass fiber (continuous strand, chopped-strand, continuous mat and/or noncontinuous mat) having a coupling agent which will provide a suitable bond between the glass reinforcement material and resin.

.3 The FRP laminate wall thickness shall vary with the we well height to provide the aggregate strength necessary to meet the tensile and flexural physical properties requirements. The wet well FRP wall laminate must be designed to withstand wall collapse or buckling based on a hydrostatic pressure of 62.4lbs per sqft; a saturated soil weight of 120 lbs per cuft; a soil modulus of 700 pounds per sqft; and the pipe stiffness values as specified in ASTM D3753. The we well FRP laminate must be constructed to withstand or exceed two times the assumed loading on any depth of the we well.

.4 The finished FRP laminate will have Barcol hardness of at least 90% of the resin manufacturers specified hardness for the fully cured resin. The Barcol hardness shall be the same for both interior and exterior surfaces.

.5 The wet well top flange shall have an outside diameter at least 4 inches greater than the inside diameter of the wet well. A four or six hole pattern shall accommodate the mounting of a cover with a least 0.25 inches in diameter 300 series stainless steel fasteners. Noncorroding stainless steel threaded inserts shall be fully encapsulated with noncontinuous mat or chopped-strand glass fiber reinforcement. The inserts shall have an offset tab to prevent stripping or spinning out when removing and reinserting cover fasteners.

.3 Sump Pit Covers

.1 Access Cover: Size and shape as shown on the drawing shall be provided for each sump pit. Cover plate shall be aluminum, capable of withstanding a live load of 300 lbs/ft2 (1465 kgs/sq. metre).

.2 The frame shall be of aluminum extrusion with a continuous door stop and grout lip integral to it.

.3 Frame shall be 1/4“(6mm) aluminum.

.4 The door shall be of aluminum tread plate, a minimum of ¼” (6mm) thick with reinforcing aluminum flat bar. A recessed lock tab for padlocking shall be provided for securing the door closed.

.5 For sanitary pits the access frame assembly shall be sealed by bolting down the lid. Seal shall be both water and air tight.

.6 For storm pumps an access frame assembly shall be provided with a separate hinged cover shall be provided for removal of each pump. A positive guided open-door latch shall engage automatically when the door is fully opened to 90 degrees. The hinges shall be of 316 stainless steel and shall be attached with stainless steel hardware. The hinges shall be tamper proof from the outside. The open-door latch must be released for closing. A retractable handle shall be provided outside of the door to assist opening and closing.

.7 Upper rail guide brackets shall be attached to the access frame. Cover shall be provided with lifting handle, safety latch to hold cover in position and locking hasp.

.4 Piping

.1 Piping: Piping shall include one swing check valve with outside lever and spring, and one plug valve. Piping shall include all necessary elbows and tees.

.2 All piping shall be coated with coal tar epoxy or equal for corrosion resistance. Where piping passes through the wall the pipes shall be sealed to make a water tight joint.

.3 Refer to section 22 13 16 for material and connections.

.5 Controls

.1 Controls: Provide packaged duplex control system. Duplex controls shall be housed in CEMA I sheet metal enclosure and shall comprise of the following:

.2 Main disconnect switch.

.3 Fuse Clips

.4 Full voltage magnetic starters complete with overload protection for each phase.

.5 110 Volt control circuit transformer.

.6 Selector switch for each pump (Hand/Off/Auto).

.7 Green pump “running” light for each pump.

.8 Red pump “fault” light. Pump fault shall be provided with a dry contact for connection to the EMCS. The pump status shall be provided by current switches provided across the starter for each motor. If the control panel calls for the pump to be running and the current switch indicates no flow an alarm shall be generated and through a dry contact an alarm shall be sent to the EMCS.

.9 High water alarm complete with audio, visual, indication and silence switch. High water alarm shall be provided with dry contact for connection to EMCS.

.10 Terminal strip for mercury type level control (Off, Primary pump on, Sec. Pump on, High level)

.11 Mercury type level controls with waterproof cables.

.12 Automatic lead, lag alternator, electric.

.6 Allow for connection of high water alarm to Building Automation System.

.7 Pumps shall be controlled as follows:

.1 On sump level rise lower switch shall first be energized, then upper level switch shall next energize and start lead pump.

.2 With lead pump operating, sump level shall lower to low switch turn off setting and pump shall stop. Alternating relay shall index on stopping of pump so that lag pump will start first on next operation and become lead pump.

.3 If sump level continues to rise when lead pump is operating, override switch shall energize and start lag pump.

.4 Both lead and lag pump shall operating together until low level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm switch shall energize and signal the alarm.

.8 Alarm signal shall close a contact to alarm at BAS. All level switches shall be adjusted for level setting from the surface.

.9 The power connection for the high level alarm must be independent of the power feed to the pump control panel.

.10 Submersible Duplex - Non-Clog Sump Pumps

.1 Pump shall be capable of handling raw unscreened sewage consisting of water, fibrous 2” (50mm) diameter spherical solids.

.2 Operating Temperature

.1 The pump shall be capable of handling liquids with temperatures of 40C (104 F) continuous, 71.1C (160 F) intermittent and shall be capable of running dry for extended periods.

.2 Where indicated on the schedule as “high temperature operation” the pump shall be capable of handling liquids with temperatures of 93.3C (200 F) continuous and shall be capable of running dry for extended periods.

.3 Pump Construction

.1 The volute, seal plates, and motor housing shall be constructed of high quality ASTM A-48 class 30 cast iron. The pump shall be painted with a water based air dry enamel of 2.0 mil minimum thickness.

.2 All exposed hardware shall be 300 series stainless steel. The pump construction shall contain no points of critical clearance nor require periodic adjustment or replacement to maintain operating efficiency.

.3 Discharge connection shall be a standard 2” (50mm) NPT in the vertical position. All caskets shall be of the compression square ring type to eliminate critical slip fits and the possibility of damage

during service associated with sliding O-ring sealing arrangements.

.4 The pump impeller shall be of a non clog design with pump out vanes on the back side. The impeller shall be dynamically balanced to ISO G6.3 specifications.

.5 The unit shall utilize a single mechanical shaft seal which will operate in an oil atmosphere. The materials of construction shall be carbon for the rotating face and ceramic for the stationary face, lapped and polished to a tolerance of one light band, 300 series hardware and all elastomer parts to be of Buna-N. The seal shall be commercially available and not a proprietary design.

.4 Motor

.1 The pump shall be designed to be non overloading throughout the entire pump curve.

.2 The rotor and stator assembly shall be of the standard frame design and secured to the pump seal plate by four threaded fasteners allowing for easy serviceability. Motor designs incorporating shrink for press fit assembly between the stator and the motor housing shall not be acceptable.

.3 The motor shall be constructed with the windings operating in a sealed environment containing clean dielectric oil, making it capable of operating in a totally, partially or non submerged condition for extended periods of time without damage due to the heat being generated. Air filled motors shall not be acceptable.

.4 The motor shall meet the standard NEMA Design L for single phase and NEMA design B for three phase. The motor shaft shall be of 416 stainless steel. The lower bearing shall be of the single ball type to accept radial loads and the upper bearing of the sleeve or ball design, for radial loads. Bearings shall operate in an oil bath atmosphere for superior lift. Permanently lubricated bearings shall not be acceptable.

.5 Thermal sensor shall be provided for use on three phase units to monitor the stator temperatures. The stator shall be equipped with a thermal switch embedded in the end coil of the stator winding. This shall be used in conjunction with external motor overload protection and wired to the control panel. Single phase shall have an overload switch on the motor windings and do not required any external protection.

.5 Power Cable

.1 The pump shall be equipped with sufficient power cable to connect to the control panel.

.2 Power cable shall be connected to the motor via quick disconnect spade terminals. Crimp connected cords are not acceptable. A secondary rubber pressure grommet shall be provided as an additional sealing point and strain relief at the point of cable entry. Cable entry designs utilizing terminal boards to connect power cord leads with motor leads are not acceptable.

.6 Pump Test

.1 The pump manufacturer shall perform the following inspections and tests in accordance with Hydraulic Institute type B standards prior to shipment from the factory.

.2 A check of the motor voltage and frequency shall be made as shown on the name plate.

.3 A motor and cable insulation test for moisture content or insulation defects shall be made per UL criteria.

.4 The pump shall be completely submerged and run to determine that the unit meets three predetermined hydraulic performance points.

.5 A written report shall be available showing the aforementioned tests have been performed in accordance with the specifications.

.7 Start Up

.1 The pump(s) shall be tested at start up by a qualified representative of the manufacturer.

.2 A start up report shall be provided by the manufacturer and shall be completed prior to final acceptance of the pump(s).

.11 Standard of Acceptance: Hydromatic, Scarboro, Barnes, Zoeller, Myers, Darling

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

.3 Set up and adjust all controls

.1 Sum Pumps

.1 Provide ball or butterfly valve, check valve and union, or flange as applicable on pump discharge pipes and union or flange as applicable on vent pipe for sanitary pits.

.2 Check valves downstream of pumps shall be swing type with external lever and adjustable weight.

.3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

.4 Place 150 mm sand under sump pit tank.

3.3 FIELD QUALITY CONTROL

.1 Check power supply.

.2 Check starter protective devices.

.3 Start-up check for proper and safe operation.

.4 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

.5 Adjust flow from water-cooled bearings.

.6 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, supplemented as specified herein.

.2 Procedures:

.1 Check power supply.

.2 Check starter O/L heater sizes.

.3 Start pumps, check impeller rotation.

.4 Check for safe and proper operation.

.5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.

.6 Test operation of HOA switch.

.7 Test operation of alternator.

.8 Adjust leakage through water-cooled bearings.

.9 Adjust shaft stuffing boxes.

.10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.

.11 Check base for free-floating, no obstructions under base.

.12 Run-in pumps for 12 continuous hours.

.13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.14 Adjust alignment of piping and conduit to ensure full flexibility at all times.

.15 Eliminate causes of cavitation, flashing, air entrainment.

.16 Measure pressure drop across strainer when clean and with flow rates as finally set.

.17 Replace seals if pump used to degrease system or if pump used for temporary heat.

.18 Verify lubricating oil levels.

3.5 DOMESTIC HW CIRCULATING PUMPS

.1 Balance flows using circuit setter balancing valve.

3.6 PV - SANITARY AND STORM WATER PUMPS

.1 Application tolerances:

- .1 Flow: Plus 10%; Minus 0%.
- .2 Pressure: Plus 10%; Minus 5%.

.2 PV Procedures:

- .1 Fill sump at rate slower than capacity of pump #1.
- .2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to draw down water level.
- .3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.
- .4 Record levels at which pumps start and stop - water level rising and water level falling.
- .5 Verify operation of alternator.
- .6 Adjust water level controls as necessary.
- .7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.
- .8 Record levels at pump starts and stops - water level rising and falling.
- .9 Check operation of alternator.
- .10 Adjust level controls as necessary.
- .11 Check level at which high water level alarm starts and stops. Adjust as necessary.

.3 Check accessibility and removal of pumps for servicing without interfering with installation or operation of other equipment.

.4 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.7 REPORTS

.1 Include

- .1 PV results on approved PV Report Forms.
- .2 Product Information report forms.
- .3 Pump performance curves (family of curves) with final point of actual performance marked thereon.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 23 - Health and Safety.

.3 Section 01 74 00 - Cleaning and Waste Processing

.4 Section 01 78 10 - Closeout Submittals.

.5 Section 21 05 00 - Common Work Results for Mechanical.

.6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.7 Section 23 07 19 – Piping Insulation.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).

.1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.5 ASME B36.19M, Stainless Steel Pipe

.2 American National Standards Institute/National Sanitation Foundation (ANSI/NSF).

.1 ANSI/NSF 61, Drinking Water System Components.

.3 American Society for Testing and Materials International (ASTM).

.1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM A536, Standard Specification for Ductile Iron Castings.

.3 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).

.4 ASTM F 492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe Fittings.

.5 ASTM A269/A269M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.6 ASTM A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

.7 ASTM A351/A351M, Standard Specification for Casting, Austenitic, for Pressure Containing Parts.

.8 ASTM A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

.9 ASTM A312/A312M, Seamless, Welded and Heavily Cold Worked Stainless Steel Pipes.

.4 American Water Works Association (AWWA).

.1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 AWWA C606, Grooved and Shouldered Joints.

.3 AWWA C228-08, Stainless-Steel Pipe Flanges For Water Service – Sizes 2 in. through 72 in. (50mm through 1800mm)

.5 Canadian Standards Association (CSA International).

.1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA).

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67, Butterfly Valves.

.2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.9 National Research Council (NRC)/Institute for Research in Construction.

.1 NRCC 38728, National Plumbing Code of Canada (NPC).

.10 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA).

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 62 00.01 - Hazardous Materials.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA , Regional and Municipal regulations.

.6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground:

.1 copper tube, hard drawn, type K: to ASTM B88M for each main riser.

.2 Above ground:

.1 copper tube, hard drawn, type L: to ASTM B88M for all other piping.

.3 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

.2 All piping shall have certification markings for compliance with ASTM B88.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 and larger:

.1 Copper: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.6 NPS 1 1/2 and smaller: wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa .

.7 Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12) or malleable iron, ASTM A 47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper coloured alkyd enamel.

2.3 JOINTS

.1 Rubber gaskets, latex-free, 1.6 mm thick: to ANSI/AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: 95/5 tin copper alloy lead free.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket. Gasket to be classified in accordance with ANSI/NSF 61 for potable water service. Couplings to be manufactured to copper-tube dimensions. Flaring of tube or fitting ends to accommodate IPS sized couplings is not permitted.

.6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 GENERAL REQUIREMENTS FOR VALVES

.1 All valves used in potable systems shall bear an NSF certification and adhere to the requirements of NSF/ANSI/CAN 61.

2.5 GLOBE VALVES

.1 NPS 2 and under, balancing, soldered:

.1 To MSS SP 80, Class 125, 860 kPa, lead free bronze body, renewable composition disc, screwed over bonnet.

.2 Lockshield handles: as indicated.

.3 Standard of Acceptance: Jenkins, Crane, Toyo 212A-LF, Kitz 812, Grinnel.

.2 NPS 2 and under, balancing, screwed:

.1 To MSS SP 80, class 125, 860 kPa, lead free bronze body, screwed over bonnet, renewable composition disc.

.2 Lockshield handles: as indicated.

.3 Jenkins, Crane, Toyo 211A-LF, Kitz 811, Grinnell.

2.6 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

.1 To MSS SP 80, class 125, 860 kPa, lead free bronze body, bronze swing disc, screw in cap, regrindable seat.

.2 Standard of Acceptance: Jenkins, Crane, Toyo 237A-LF, Kitz 823, Grinnell.

.2 NPS 2 and under, screwed:

.1 To MSS SP 80, class 125, 860 kPa, lead free bronze body, bronze swing disc, screw in cap, regrindable seat.

.2 Jenkins, Crane, Toyo 236A-LF, Kitz 822, Grinnell.

.3 NPS 2 1/2 and over, flanged:

.1 300 PSI, epoxy coated cast iron body, EPDM seat, bronze disc.

.2 Standard of Acceptance: Jenkins, Crane, Toyo 435, Kitz 78, Grinnell.

.4 NPS 2 1/2 and over, flanged:

.1 Grade CF8M to ASME B16.34, class 125, 860 kPa, stainless steel body, FF flange, regrind renewable seat, stainless steel disc, bolted cap.

.2 Standard of Acceptance: Jenkins, Crane, Toyo, Kitz 150UOM, Grinnell.

2.7 BALL VALVES

.1 NPS 3/4 to 2, branch isolators, screwed:

.1 600 WOG, lead free bronze body, solid chrome plated bronze ball, with Teflon seal.

.2 Ball valves shall have full port opening.

.3 Standard of Acceptance: Jenkins, Crane, Toyo 5044A-LF, Kitz 858, Grinnell, Apollo, Dahl, MAS B-1F-LF-SS.

.2 NPS 1/2 and under, fixture isolators, screwed or solder:

.1 Lead free bronze body, solid chrome plated bronze ball.

.2 Quarter turn.

.3 Standard of Acceptance: Dahl

2.8 BUTTERFLY VALVES

.1 NPS 2 1/2 and Over Full Lug Body (1380 kPa) to NSF 372 of 61:

.1 To be lug type, MSS SP 67, 1380 kPa WOG water, cast iron or ductile iron body with epoxy coated cast iron or aluminum bronze disc (nickel coated discs are not acceptable), 416 stainless steel stem, EPDM liner, with notched top plate and lever lock handle for valve sizes NPS 4 and smaller, and worm gear operator with hand wheel for valves NPS 6 and larger. Lugs shall be tapped. Valves to be bubble tight shutoff up to 1380 kPa rating if downstream equipment is removed. (full dead end service)

.2 Utilize for all on/off applications with operating pressures 1380 kPa and less.

.3 Operator

.1 NPS 6 and under: lever handle.

.1 Standard of Acceptance: Kitz 6122EL, Toyo 918BESL, MAS D Series

.2 NPS 8 and over: gear operated

.1 Standard of Acceptance Kitz 6141EG, Toyo 918BESG, MAS D Series

2.9 WATER METER

.1 The Water Meter shall be obtained from the local authority and installed by the Division 22 Contractor.

.2 The Division 22 Contractor shall be responsible for the associated costs required to obtain the Water Meter from the local authority.

.3 Meter shall be provided with the provision to tie into the Building Automation System.

PART 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Ontario Plumbing Code and local authority having jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05 – Installation of Pipework and by certified journeyperson supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Grooved joint couplings and fittings to be installed in accordance with the manufacturer’s written installation instructions. Grooved ends to be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets to be verified as suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory trained representative to provide on-site training for Contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative to periodically visit the jobsite and review installation. Contractor to remove and replace any joints deemed improperly installed.

.5 Install domestic cold water piping below and away from HWS and HWR and other hot piping so as to maintain temperature of cold water as low as possible.

.6 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.7 Buried Tubing

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.2 VALVES

.1 Isolate equipment, fixtures and branches with butterfly or ball valves.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 WATER METER

.1 The products utilized to build the water meter assembly shall be in accordance with the Local Authorities requirements.

.2 The Division 22 Contractor shall be responsible for reviewing the required installation detail provided by the Local Authority.

3.4 PRESSURE TESTS

.1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.

.2 Test pressure: greater of 1 ½ times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

.1 New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority having jurisdiction or in the absence of a prescribed method as follows:

.1 The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.

.2 The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200mg/l) of chlorine and allowed to stand for three (3) hours.

.3 Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.

.4 The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

3.6 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.7 START-UP

.1 Timing: Start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor HWS and HWR piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

.1 Timing:

.1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB HWR in accordance with Section 23 05 93 - Testing Adjusting and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize HWS and HWR systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 13 – General Commissioning (CX) Requirements: using report forms as specified in Section 01 91 13 – General Commissioning (CX) Requirements.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section includes:

.1 The installation of drainage waste and vent piping – cast iron and copper.

1.2 RELATED SECTIONS

.1 Section 01 35 23 - Health and Safety.

.2 Section 01 74 00 - Cleaning and Waste Processing

.3 Section 21 05 00 – Common Work Results for Mechanical

1.3 REFERENCES

.1 American Iron and Steel Institute (AISI)

.1 AISI 304, Stainless Steel.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM B32, Specification for Solder Metal.

.2 ASTM B306, Specification for Copper Drainage Tube (DWV).

.3 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.3 Canadian Standards Association (CSA International)

.1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.2 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.

.3 CAN/CSA- B125.3, Plumbing Fittings.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.6 SUBMITTALS:

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, storm and vent Type DWV to: ASTM B306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.

.2 Wrought copper: to CAN/CSA-B125.

.3 ASTM B88

.4 ASTM C564

.2 Solder: tin-lead, 50:50, type 50A to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary, storm and vent minimum NPS3, to: CAN/CSA-B70,

.1 Refer to Specification Section 22 13 17 – Drainage Waste and Vent Piping - Plastic

.2 Above ground sanitary, storm and vent: to CAN/CSA-B70.

.1 Joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 STAINLESS STEEL PIPE AND FITTINGS

.1 Above ground and buried sanitary, storm and vent, NPS 2 to NPS 10, stainless steel, type AISI 304.

.1 Mechanical Joints:

.1 Push-fit socket joint with EPDM sealing ring.

2.4 PUMPED DRAINAGE

.1 Pumped drainage shall be Schedule 40 CPVC

PART 3 Execution

3.1 INSTALLATION

.1 By a certified journeyperson.

.2 Install in accordance with Ontario Plumbing Code and local authority having jurisdiction.

.3 Where piping passes through floor or wall below grade pack and seal in concrete complete with Link Seal in accordance with Specification Section 22 05 01.

.4 PVC piping shall not be utilized above grade with exception for the branch from the urinals. PVC piping as specified in Section 22 13 17 is acceptable for below grade piping. The PVC piping shall convert to cast iron prior to the point where it penetrates the floor slab.

.5 Provide venting to plumbing fixtures and fixture groups in accordance with the Ontario Building Code Plumbing Code and local authorities having jurisdiction.

3.2 TESTING

.1 The drainage and vent system shall be tested in accordance with the Ontario Building Code - Plumbing Code and tested in accordance with the requirements of the authority having jurisdiction, perform tests in the presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.

.2 Perform tests before piping is covered or concealed.

.3 Remove all fittings which will not withstand test pressure and replace after test.

.4 Eliminate leaks, or remove and refit defective parts.

3.3 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge, etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

.6 Provide copies of test reports for Commissioning Manuals.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section includes:

.1 The supply and installation of washroom fixtures and trim.

.2 Products installed but not supplied under this section as indicated elsewhere in the contract:

.1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.

.2 Equipment installed by others.

.1 Connect with unions.

.3 Equipment not installed.

.1 Capped for future connection by others.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 23 – Health and Safety.

.3 Section 01 74 00 – Cleaning and Waste Processing.

.4 Section 01 78 10 - Closeout Submittals.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI 112-19.2, Ceramic Plumbing Fixtures.

.2 American National Standards Institute/national Sanitation Foundation (ANSI/NSF)

.1 ANSI/NSF 61, Drinking Water System Components.

.3 Canadian Standards Association (CSA)

.1 CAN/CSA-B45 Series, Plumbing Fixtures.

.2 CAN/CSA-B125, Plumbing Fittings.

.3 CAN/CSA-B651, Barrier-Free Design.

.4 Provincial Accessibility Act Regulations.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: Submit WHMIS MSDS – Material Safety Data Sheets.

.3 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.4 Indicate fixtures and trim:

.1 Dimensions construction details, roughing-in dimensions.

.2 Factory-set water consumption per flush at recommended pressure.

.3 For water closets, urinals: minimum pressure required for flushing.

.5 Closeout Submittals:

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 10 – Closeout Submittals.

.2 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

.3 with Section 01 35 23 – Health and Safety.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing

.2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.6 WARRANTY

.1 Provide a written guarantee, signed and issued in the name of the owner, against defective materials and workmanship for a period of one (1) year from the date of Substantial Completion.

PART 2 Products

2.1 GENERAL

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Unless otherwise noted exposed plumbing brass to be chrome plated.

.4 Number, locations: Architectural drawings to govern.

.5 Fixtures to be product of one manufacturer and of same type.

.6 Trim to be product of one manufacturer and of same type.

.7 Provide cast brass chrome plated escutcheon plates with set screws on all water and drain pipes where such lines pass through, floors, walls and partitions.

.8 Plumbing fixtures shall be as indicated and specified with all required supports, accessories, wastes, vent and water connections as required to make the fixture complete.

PART 3 Execution

3.1 INSTALLATION

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

.2 Wall-hung fixtures: as indicated, measured from finished floor.

.3 For barrier-free washrooms: to comply with most stringent of either NBCC or CAN/CSA B651, or Provincial Building Accessibility Act and Regulations.

.4 Provide venting for all plumbing fixtures as required by codes.

.5 Provide chrome plated flexible supplies to fixtures with screw driver stops, reducers and escutcheons.

.6 All piping shall be recessed unless otherwise approved. Piping to be installed in areas shall be run in neat parallel lines as tight as possible to walls and ceilings.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.1 Adjustments.

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Adjust flush valves to suit actual site conditions.

.4 Adjust urinal flush timing mechanisms.

.5 Automatic flush valves for urinals and water closets: set controls to prevent unnecessary flush cycles during silent hours.

.2 Checks.

.1 Water closets, urinals: flushing action.

.2 Aerators: operation, cleanliness.

.3 Vacuum breakers, backflow preventers: operation under all conditions.

.3 Thermostatic controls.

.1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Use of HVAC systems during construction.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities.

1.3 USE OF SYSTEMS

.1 Use of new and/or existing permanent heating and/or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.4 There is no possibility of damage from any cause.

.5 Supply ventilation systems are protected by Merv 11 filters, which shall be inspected daily, changed every week or more frequently as required.

.6 Return systems have a minimum of Merv 11 over all openings, inlets, outlets.

.7 All systems will be:

.1 Operated and monitored continuously by the Mechanical Contractor

.2 Operated as per manufacturer's recommendations or instructions.

.8 The condition of the filters shall be inspected and documented daily. Written report of filter condition to be submitted on a weekly basis to the Consultant.

.9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Consultant.

.10 Warranties and guarantees are not thereby relaxed.

.11 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Owner’s Representative.

.12 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, and replace filters in air systems.

.2 Filters specified in this section are over and above those specified in other sections of this project.

.3 Exhaust systems are not included in any approvals for temporary heating ventilation.

PART 2 Products (NOT used)

PART 3 Execution (NOT used)

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit specified in Division 26. Control wiring 50V or less for systems specified in Division 21, 22, 23 and 25 is by Division 25.

1.2 RELATED SECTIONS:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 National Energy Code for Buildings (NECB).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.4 National Electrical Manufacturers Association (NEMA).

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures

.2 Shop Drawings: Submit drawings stamped and signed for approval by Owner's Representative.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Owner's Representative will make available 1 (one) copy of systems supplier's installation instructions.

.4 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with Canadian Environmental Protection Act (CEPA), Canadian Environmental Assessment Agency (CEAA), Transportation of Dangerous Goods Act (TDGA) and applicable Provincial regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

PART 2 Products

2.1 GENERAL

.1 Motors to be premium efficiency, in accordance with local hydro company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

.1 Motors shall be designed for severe duty in accordance with IEEE 841 standards and shall meet NEMA MG1 Part 31.

.2 All motors below 0.5 HP shall be rated for either 208V 3-phase or 1 phase, 600 V 3-phase or 1-phase or 120V, 1-phase, 60 Hz supply as indicated in the schedule.

.3 All motors larger than 0.5 hp shall be rated for either 208V 3-phase or 575 3-phase, 60 Hz supply as indicated in the schedule.

.4 All motors shall be either Open Drip Proof (ODP) or totally-enclosed fan-cooled (TEFC) enclosure as indicated in the schedules.

.5 TEFC motors shall be rated to IP55. A non metallic cooling fan shall be provided. Frame, end bells and fan cowl shall be manufactured of heavy duty cast iron. The end plates shall be sealed to the frame joints. Enclosure shall be epoxy coated and rated for ASTM B117-90 96 hour salt spray test.

.6 Motors shall be furnished in NEMA frame size 143T and larger. Frame sizes smaller than 143T are not acceptable. Motors in frame sizes larger than 449T shall have form wound windings.

.7 Motor windings shall have a minimum of NEMA class F insulation with class B temperature rise ratings. Windings shall be 200C inverter spike resistant wire. Motor windings shall withstand 2000V transients. Motor service factor shall be 1.15 on sine wave power and 1.0 on VFD power.

.8 Bearings shall be regreasable without disassembly and provide for the elimination of purged grease. Bearing life shall be a minimum of L10 at 50000 hours. Bearing seals shall be Inpro or equivalent.

.9 Motors shall be balanced to less than 0.08 inches per second (filter out) and the vibration test data shall be shipped with the motor.

.10 Nameplates shall be stainless steel and contain both NEMA data and bearing data.

.11 Motors used with variable frequency drives shall be provided with a brush system to electrically ground the shaft and discharge any induced voltage on the motor shaft, with a direct path to ground.

.12 Motor shall be provided with a 3 year warranty.

.13 Acceptable motor manufacturers are Reliance-Baldor, US Motors, and TECO-Westinghouse.

2.3 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave to be determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 – Closeout Submittals.

2.4 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.

.3 38 mm dia. holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 GROUNDING OF MOTORS CONNECTED TO VARIABLE FREQUENCY DRIVES

.1 All motors that are connected to Variable Frequency Drives shall be grounded as follows:

.1 The conduit from the VFD to the motor shall be provided with a grounding strap on the outside of the conduit.

.2 The strap shall be connected to the VFD enclosure and the motor grounded frame.

.3 Within the conduit a grounding conductor shall be run connecting the motor ground to the VFD ground.

.4 The shield over the cable shall be connected to the ground bus in the drive and terminated at the motor end to the grounded motor.

3.4 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in SUBMITTALS.

.1 As specified in other sections of this specification.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 00 – Cleaning and Waste Processing

.2 Section 23 21 14 - Hydronic Systems

1.2 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers. (ANSI/ASME)

.1 ANSI/ASME B31.1, Power Piping.

.2 ANSI/ASME B31.3, Process Piping.

.3 ANSI/ASME B31.5 – Refrigeration Piping and Heat Transfer Components.

.4 ANSI/ASME B31.9 Building Services.

.5 ANSI/ASME Boiler and Pressure Vessel Code

.1 Section I: Power Boilers.

.2 Section V: Non-destructive Examination.

.3 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1, Recommended Practices for Resistance Welding.

.2 AWS Z49.1, Safety Welding, Cutting and Allied Process.

.3 AWS W1, Welding Inspection Handbook.

.4 Canadian General Standards Board

.1 CAN/CGSB-48.2, Spot Radiography of Welded Butt Joints in Ferrous Materials.

.5 Canadian Standards Association (CSA International)

.1 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48 series-, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA B52 Mechanical Refrigeration Code.

.5 CSA W117.2, Safety in Welding, Cutting and Allied Processes.

.6 CSA W178.1, Certification of Welding Inspection Organizations.

.7 CSA W178.2, Certification of Welding Inspectors.

.6 Provincial regulations: Boiler, Pressure Vessel and Compressed Gas Regulations.

1.3 QUALIFICATIONS

.1 Welders

.1 Welding qualifications in accordance with CSA B51

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Furnish welder's qualifications to Owner’s Representative.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors

.1 Inspectors qualified to CSA W178.2.

1.4 QUALITY ASSURANCE

.1 Registration of welding procedures in accordance with CSA B51, CSA B52 and provincial regulations.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 00– Cleaning and Waste Processing, and with the Waste Reduction Workplan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative.

PART 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

PART 3 Execution

3.1 WORKMANSHIP

.1 Welding: in accordance with ANSI/ASME B31.1 B31.3, B 31.5, B31.9, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS C1.1, and special procedures specified elsewhere in Mechanical Division and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Owner's Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Owner's Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

.1 General

.1 Perform examinations and tests by specialist engaged by contractor, qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Owner's Representative.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 In accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and/or spot or full gamma ray radiographic (hereinafter referred to as "radiography") tests. As per applicable reference standard or as specified.

.4 All steam piping shall be mag particle tested and radiographically tested based on the following sequence:

.1 20% shall be tested utilizing magnetic particle test, anything that fails the magnetic particle test shall be followed up with a radiographic testing. The Contractor may test more than 20% based on the testing conducted up to that point, this is at the contractor's discretion.

.2 An additional 10% of randomly selected welds or areas that may be difficult to repair shall be tested by radiographic testing.

.3 At a minimum 20% mag particle and visual inspection plus 10% radiographic testing shall be completed. The testing procedure could accumulate to 30% testing if 20% of the mag particle testing fails.

.5 Testing of Chilled Water systems as required per item 3.6.2.6.

.2 Hydrostatically test welds to requirements of ANSI/ASME B31.1.

.3 Visual and Magnetic Particle examinations: include entire circumference of weld externally and wherever possible internally.

.4 Radiography testing to CAN/CGSB-48.2.

.1 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to Owner's Representative. Replace film if rejected because of poor quality.

.2 Interpretation of radiographic films:

.1 By qualified radiographer.

.3 Failure of radiographic tests:

.1 Extend tests to welds by welder responsible when those welds fail tests.

.5 Magnetic particle tests for piping systems as indicated.

3.5 WELDING FUMES

.1 Contractor shall use welding fume extraction and filtration systems to minimize smoke propagation thru building areas.

.2 For all welding in tunnel spaces provide air moving fans at all times during construction to facilitate air transfer tunnel to outside.

.3 Provide three HEPA air scrubbers (rated at 2,000CFM) complete with all accessories in immediate area of welding work to provide local air filtration.

.4 Contractor shall be responsible for all costs associated with setup of fume extraction equipment, air circulation fans, HEPA air scrubbers, etc. including location nearest power supply/receptacle and providing all required extension cords, plug adapters, etc. for complete operational system.

.5 Proposed location of air circulation fans are indicated on drawings for reference only. Contractor shall complete final adjustments in field to ensure effective transfer of fumes.

.6 Provide all necessary accessories including extension cords, plugs, etc. to ensure fully operating system.

.7 Welding in areas utilized as a plenum for air handling systems (eg. penthouse room used as a return air plenum) shall be completed afterhours once air handling systems are scheduled off. Coordinate with the facility management.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.2 In addition, chilled water systems below 1000 kPa:

.1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.

.2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.

.3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.

.4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.

.5 Repair cracks and defects in excess of 0.8 mm in depth.

.6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic particle tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

.2 Materials and components for metering of the following systems:

.1 Hot Water systems

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 74 00 – Cleaning and Waste Processing

.3 Section 23 05 53 – Mechanical Identification

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.

.3 ASME Fluid Meter's Handbook, Their Theory and Application

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings and product data.

.3 Submit manufacturer’s product data for following items:

.1 Thermometers

.2 Pressure Gauges

.3 Ball Valves

.4 Syphons

.5 Wells

1.5 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing

.2 Collect, separate and place in designated containers for reuse and recycling, paper, plastic, polystyrene, corrugated cardboard packaging, steel, metal, in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

.4 Place materials defined as hazardous or toxic waste in designated containers.

.5 Ensure emptied containers are sealed, labelled and stored safely for disposal away form children.

PART 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range for Thermometers and Pressure Gauges.

.2 Ranges: dual imperial and metric for Thermometers and Pressure Gauges.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, accuracy ± l scale division, 225 mm scale length: to CAN/CGSB14.4 or ASME B40.200.

2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter liquid filled or vapor activated dial type: to CAN/CGSB-14.4 or ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass or stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.5 PRESSURE GAUGES

.1 Dial type: 112 mm to ASME B40.100, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale, 1% accuracy for liquid filled.

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketed pressure relief back with solid front.

.5 Bronze ball valve to Section 23 05 23.01 – Valves – Bronze.

.6 Oil filled for high vibration applications, such as pumps.

PART 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as follows:

.1 At all air handling units on the fluid supply and return lines.

.2 For all pumped coils provide a thermometer in the supply and return from the coil in addition to the supply and return from the system.

.3 At all supply and return headers.

.4 In the fluid supply and return for all glycol and water heat exchangers.

.5 In the supply for line for all boilers.

.6 In the supply and return for the chilled water and condenser water for all chillers.

.7 Provide for fan coils where required by Drawing Details.

.8 Provide for reheat coils where required by Drawing Details.

.9 Hot water supply for all domestic hot water tanks.

.3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRV's.

.3 Upstream and downstream of control valves.

.4 Inlet and outlet of coils.

.5 Inlet and outlet of liquid side of heat exchangers.

.6 Outlet of boilers.

.7 At all expansion tanks.

.8 Provide in the inlet and the discharge of all pressure reducing valves.

.9 Provide in the header for all steam boilers.

.10 Provide at air handling units when indicated on the Drawing Details.

.11 Provide at fan coils when indicated on the Drawing Details.

.12 Provide one gauge piped across the supply and return for all pumps. Pipe in accordance with Drawing Details.

.13 Provide one gauge piped across the supply and return for all glycol and water heat exchangers. Pipe in accordance with Drawing Details.

.14 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

1 General

1.1 Summary

.1 Section includes:

.1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing

.3 Section 03 30 00 - Cast-in-Place Concrete.

.4 Section 05 12 00 - Structural and Steel Framing

.5 Section 05 50 00 - Metal Fabrications.

.6 Section 21 05 00 - Common Work Results for Mechanical

1.3 References

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1, Power Piping, (SI Edition).

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A125, Specification for Steel Springs, Helical, Heat Treated.

.2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.

.4 ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process

.5 ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel

.6 ASTM A 123/A 123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.7 ASTM A 153/A 153M, Standard Specification for Zinc Coating (Hot-Dip Galvanized) on Iron and Steel Hardware

.8 ASTM D 1929, Standard Test Method for Determining Ignition Temperature of Plastics

.3 Factory Mutual (FM)

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).

.1 Materials Safety Data Sheets (MSDS).

.5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 Underwriter's Laboratories of Canada (ULC)

.7 NFPA

.1 NFPA-13, Standard for Installation of Sprinkler Systems

1.4 System description

.1 Design Requirements

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.2 Performance Requirements

.1 Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the Ontario Building Code

1.5 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop drawings: submit drawings stamped and signed for approval by Owner’s Representative.

.3 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Owner's Representative will make available 1 copy of systems supplier's installation instructions.

.5 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals

1.6 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

2 Products

2.1 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 Pipe Hangers

.1 General

.1 Provide spring hangers where specified

.2 Provide saddles for all insulated pipes and prefabricated insulation shields with high density insulation with vapour barriers for domestic cold water piping.

.3 For all domestic cold water piping the hangers shall be oversized to fit over the outside of the insulation.

.4 Supports, guides and anchors shall be designed so that excessive heat will not be transmitted to the structure.

.5 Where piping is subjected to shock loads, such as thrust imposed by the activation of safety valves hanger design shall include the provision of rigid restraints or shock absorbing devices of approved design.

.6 The pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping and prevent excessive stress resulting from transferred weight being introduced into the connected equipment.

.7 Hangers shall adequately support the piping system. They shall be located near or at changes in piping direction and as close as possible to concentrated loads. They shall provide a means for vertical adjustment after erection to maintain pitch required for proper drainage.

.2 Finishes:

.1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.

.2 Use electro-plating galvanizing process or hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.3 Upper attachment structural: Suspension from lower flange of I-Beam.

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed, 13 mm FM approved.

.2 Cold piping NPS 2 1/2 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.

.4 Upper attachment structural: Suspension from upper flange of I-Beam.

.1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.

.5 Upper attachment to concrete.

.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.

.6 Shop and field-fabricated assemblies.

.1 Trapeze hangar assembly: MSS SP-89.

.2 Steel brackets: MSS SP-89.

.3 Sway braces for seismic restraint systems: to MSS SP-89.

.7 Hanger rods: threaded rod material to MSS SP-58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.8 Pipe attachments: material to MSS SP-58.

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation saddles for hot pipework.

.4 Oversize pipe hangers and supports for insulated pipes.

.9 Adjustable Swivel Ring Hangers

.1 Utilize adjustable swivel ring hangers for:

.1 Pipe Sizes 2-1/2” (65mm) and smaller

.2 Pipe Sizes 2-1/2” (65mm) and larger

.2 Hanger shall constructed of carbon steel.

.3 Hanger to be UL, ULc and FM approved.

.4 For sprinkler piping applications the swivel hanger shall meet the requirements of the NFPA.

.5 Swivel nut shall provide vertical adjustment once the pipe is in place.

.6 For non insulated copper pipe utilize either copper plated or epoxy coated hangers.

.7 Standard of Acceptance uninsulated steel pipe: Hunt Fig. #20, Myatt, Anvil Fig.69.

.8 Standard of Acceptance uninsulated copper pipe: Hunt Fig #20C or Hunt Fig # 20E, Myatt, Anvil Fig. CT-69.

.9 Standard of Acceptance insulated copper or steel pipe: Hunt Fig # 25H, Myatt, Anvil, Cooper B-Line

.10 Adjustable clevis Hangers

.1 Utilize adjustable clevis hangers for:

.1 Pipe Sizes 2-1/2” (65mm) and larger

.2 Material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.3 Ensure "U" has hole in bottom for riveting to insulation shields.

.4 Hanger shall be constructed of carbon steel.

.5 Hanger to be UL, ULc and FM approved.

.6 Hanger shall provide vertical adjustment once the pipe is in place. For sizes 5” (125 mm) and larger utilize rod with two nuts. For sizes less than 5” (125 mm) utilize bolt and nut.

.7 For non insulated copper pipe utilize either copper plated or epoxy coated hangers.

.8 For roller hangers provide cast iron roller.

.9 Standard of Acceptance uninsulated steel pipe: Hunt Fig #32, Myatt, Anvil, Cooper B-Line.

.10 Standard of Acceptance uninsulated copper pipe: Hunt Fig 30C or 30E, Myatt, Anvil Fig 65 epoxy coated, Cooper B-Line.

.11 Standard of Acceptance insulated copper or steel pipe: Hunt Fig 32U, Myatt, Anvil Fig 260, Cooper B-Line.

.11 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.

.12 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.

.13 Pipe rollers:

.1 cast iron roll and roll stand with carbon steel rod to MSS SP-69.

.1 Trapeze Hangers

.1 Hanger shall be tube construction constructed of 12 gauge rolled form ASTM 1011 structural steel Gr. 33 structural steel channel with galvanized finish.

.2 Hanger shall be sized for the total weight of the pipes, concentrated loads, water and insulation supported on the trapeze.

.3 Trapeze assembly shall be supported by a minimum of two rods with washer plates sized for the total weight of the pipes, concentrated loads and fluids within the pipes.

.4 All insulated pipe shall be provided with insulation shields and high-density insulation so that the insulation can be supported above the trapeze.

.5 Pipes mounted on trapeze hangers shall be guided by a U bolt every second hanger.

.6 Trapeze hangers shall be sized as follows:

Trapeze Hangers												
Tubing Size	**Maximum Load (lbs) based on the following distance between supports (inches) at a maximum temperature of 250 F.**											
	18”	**20”**	**22”**	**24”**	**26”**	**28”**	**30”**	**36”**	**42”**	**48”**	**54”**	**60”**
3/16” x 4” x 3”	5800	5200	4800	4400	3900	3600	3500	2900	2500	2200	1900	1700
¼” x 4” x 4”	10200	9100	8300	7500	7000	6500	6100	5100	4300	3800	5300	4800
¼” x 6” x 4”				12000	11100	10300	9600	8000	6800	6000	5300	4800
¼ “ x 8” x 4”				20000	18400	17100	16000	13300	1140 0	10000	8800	8000

2.3 Riser Clamps

.1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.

.2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

.5 For uninsulated copper pipe utilize copper plated riser clamp.

.6 Standard of Acceptance: Hunt Fig #40, 41, 42C, Myatt, Anvil Fig 261, Cooper B-Line.

2.4 Insulation Protection Shields

.1 Insulation shields shall be constructed of carbon steel and shall be galvanized.

.2 Insulation shields shall be utilized in conjunction with high compressive strength inserts.

.3 For pipes sizes NPS 5 and smaller the minimum metal thickness shall be 0.12" (3.2 mm).

.4 For pipes sizes NPS 6 and larger the minimum metal thickness shall be 0.19", (4.8 mm).

.5 Shields shall 12" (300 mm) in axial length and shall span an arc of approximately 180 degrees.

.6 Shields for pipe sizes NPS 12 and larger shall have a centre rib.

.7 Insulated cold piping:

.1 64 kg/m3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.8 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

.9 Standard of Acceptance: Hunt, Myatt, Anvil Fig 167, Cooper B- Line or approved alternate.

2.5 Constant Support Spring Hangers

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).

.2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 Variable Support Spring Hangers

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.1 ROOF MOUNTED PIPE SUPPORT AND PIPE CROSSOVER SYSTEMS

.1 General

.1 Provide rooftop support system for all roof mounted piping, size to suit pipe size, weight and quantity. Refer to drawing M-3.4 for piping layouts.

.2 Materials

.1 Bases are high density polypropylene with UV inhibitors and anti-oxidants conforming to following:

.1 Color: Black color as molded

.2 Moisture Content: negligible

.3 Shrinking/Swelling due to moisture: Negligible

.4 Resistant to oil, gasoline, antifreeze, battery acid and sulfuric acid

.5 Do not use bases that are made of pressed rubber, steel, stainless steel, recycled tires or carbonated plastics

.3 Base Dimensions:

.1 18-inches wide by 18-inches long by 3-inches tall (18x18)

.2 Base Size: 18" x 18" x 3", or 18" round

.3 Base Weight: 7 lbs and 10-1/2 lbs

.4 Base Material: Injection molded high density/high impact polypropylene with UV-inhibitors and Antioxidants

.5 Base Color: Black

.6 Base Density: 55.8 lb/cu ft (894 kg/cu m)

.7 Steel frame: Steel, 12ga 1-5/8” or 1-7/8” strut galvanized per ASTM A123 or 14ga 13/16” strut galvanized per ASTM A653 for PP10 and SS8.

.4 Hanger Type:

.1 Conforms to MSS SP-58 and MSS SP-69

.2 Material: Carbon steel(Standard); 304 SS available

.3 Clevis Hanger: Used for all insulated and uninsulated lines

.4 Roller Hanger: Used for uninsulated lines

.5 Finish: Hot Dipped Galvanized (HDG)

.5 Walkway Surface

.1 Interlocking Planking:

.1 Thickness: 18 gauge

.2 Section width: 12 inches(305 mm) standard, or 6 inches(152 mm)

.3 Planking height: 2.5 inches

.4 Flange options: MM/MF

.5 Surface: Slip resistant

.6 Finish: HDG

.2 Bar Grating: Type WB-4

.1 1" x 3/16" Bearing Bars, 1-3/16" on Center, Regular Cross Bars 4"

.2 Width: 24 inches(standard), or 36 inches – as required

.3 Surface: Serrated

.4 Finish: HDG

.3 Handrail

.1 12 gauge, 1-5/8” strut, Galvanized

.4 Attaching hardware

.1 HDG threaded rod, nuts and attaching hardware per ASTM A153.

.6 Piping Supports

.1 Multiple Hydronic Pipes

.1 Designed to support multiple hydronic and refrigerant pipes at most any specified height above the roof surface. The frame supports the pipe from below using the cross bar.

.2 Support Spacing subject to local codes and authorities but will not exceed 10 feet

.3 Bracing required when using base with swivel, when pipe exceeds 24 inches above roof, or when thermal expansion of pipe is great

.4 Size and width to suite piping size/weigth/quantity.

.5 Systems shall be designed for seismic and high wind application.

.6 Product: PHP Systems PSL, Miro Industries

.7 Crossover and Equipment Access Platform

.1 All walkway systems shall be installed directly on the roof without penetrating the roof surface.

.2 Systems allow technicians and service professionals to gain safe and convenient access to varying roof levels and equipment otherwise encumbered by rooftop pipes, ducts, and other types of rooftop components.

.3 Height of cross over to suit pipe height.

.4 Height of cooling tower access platform to suit access door and fil media, coordinate final height with structural drawigns.

.5 Product: PHP Systems Crossover, Miro Industries

2.2 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.3 Equipment Anchor Bolts and Templates

.1 Provide templates to ensure accurate location of anchor bolts.

2.4 Platforms and Catwalks

.1 To Section 05 50 00 - Metal Fabrication.

2.5 House-keeping Pads

.1 For all boilers, pumps, air compressors, fans and other rotating equipment installed on the floor or specified in individual sections, provide chamfered edge housekeeping pads a minimum of 4" (100 mm) high and 4" (100 mm) larger than equipment dimensions all around.

.2 For all air handling units provide housekeeping pads so that units are mounted on chamfered edge housekeeping pads a minimum of 4" (100 mm) larger than the equipment dimensions all around as follows:

.3 Total Static Pressure Less than or equal to 5” WC – 150mm (6”) housekeeping pad

.4 Total Static Pressure Greater than 5” WC – 200mm (8”) housekeeping pad

.5 Work shall be performed by the trades specializing in this work.

.6 Concrete: to Section 03 30 00 - Cast-in-place Concrete by Division 3.

2.6 Other Equipment Supports

.1 From structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with shop drawings.

3 Execution

3.1 Manufacture's instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, elsewhere as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 vertical movement of pipework is 13 mm or more,

.2 transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 transfer of load to adjacent piping or to connected equipment is not critical.

.2 variation in supporting effect does not exceed 25 % of total load.

3.3 Hanger Spacing

.1 Plumbing piping: to Ontario Plumbing Code.

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.4 Govern spacing between pipe rack supports using smallest pipe size.

.5 All hanger rods shall be galvanized or painted with red chromate primer.

.6 Rods shall be threaded at both ends or be provided with a continuous thread. Use adjusting locknuts at upper attachments and hangers. No wire, chain or perforated straps shall be allowed.

.7 Use rod diameters and spacing for pipe supports as shown in table with following exceptions:

.1 Support plumbing piping in accordance with more stringent requirements of authorities having jurisdiction or as specified.

.2 Support NPS 1/2 copper pipe every 5 ft (1.5 m).

.8 Hanger Support

.1 Support fire protection piping in accordance with NFPA codes.

.2 Support plumbing piping in accordance with the Ontario Building Code, and the following:

.1 Support all vertical soil pipe, vents, waste stacks and rain water leaders at every floor with steel pipe clamps.

Pipe Size NPS	Rod Diameter	Maximum Spacing:	
		Steel	Copper
up to, 3/4	3/8" (10 mm)	7 ft (2.1 m)	6 ft (1.8 m)
1	3/8" (10 mm)	7 ft (2.1 m)	6 ft (1.8 m)
1-1/4	3/8" (10 mm)	7 ft (2.1 m)	6 ft (1.8 m)
1-1/2	3/8" (10 mm)	9 ft (2.7 m)	8 ft (2.4 m)
2	3/8" (10 mm)	10 ft (3 m)	9 ft (2.7 m)
2-1/2	½" (12 mm)	12 ft (3.6 m)	10 ft (3 m)
3	½" (12 mm)	12 ft (3.6 m)	10 ft (3 m)
3-1/2	½" (12 mm)	13 ft (3.9 m)	11 ft (3.3 m)
4	5/8" (16 mm)	14 ft (4.2 m)	12 ft (3.6 m)
5	5/8" (16 mm)	16 ft (4.8 m)	
6	7/8" (22 mm)	17 ft (5.1 m)	
8	7/8" (22 mm)	19 ft (5.7 m)	
10	7/8" (22 mm)	22 ft (6.6 m)	
12	7/8" (22 mm)	22 ft (6.6 m)	
14 and 16	1” (25mm)	22 ft (6.6 m)	
18	1 1/8” (28mm)	22 ft (6.6 m)	
20	1 ¼” (32mm)	22 ft (6.6 m)	
24	1 ½” (40mm)	22 ft (6.6 m)	

.9 Within 300 mm of each elbow.

.10 Pipework greater than NPS 12: to MSS SP69.

3.4 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.

.4 All hangers shall be directly hung from the structure. No hangers shall be installed or supported off other pipes, ducts, equipment, or steel decks.

.5 Where necessary to support piping from floor, use concrete pier base with cast iron pipe rest with floor flange and pipe roll stands.

.6 Where multiple pipes run parallel at the same elevation trapeze hangers may be utilized. Trapeze hangers shall be spaced according to the smallest pipe size.

.7 All hangers and connections to open web steel joists, must be made at the panel joints. It is not structurally acceptable to impose any loads on either the top or bottom chord of the joist, between panel points. The maximum working load that can be suspended from a joist panel point is not to exceed 1.0 kN. Loads must be applied so that they do not cause twisting of the joists.

.8 All vertical piping shall be supported by the horizontal pipe, or a pedestal support or the foundation at the base of the riser and riser clamps at each floor level for cast iron or PVC pipe and every other floor for steel and copper pipe. For floors greater than 12 feet (3650 mm) provide riser clamps at every floor. Wherever possible locate riser clamps directly below the pipe couplings or shear lugs.

.9 All hangers exposed to the Outdoors shall be hot dipped galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor use.

.10 All hangers exposed in Corrosive Areas shall be type 304 stainless steel with stainless steel hardware.

3.5 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical. If they do roller hangers shall be utilized.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

.2 Sustainable requirements for construction and verification.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing

.3 Section 09 91 00 - Paint and Coatings.

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-24.3, Identification of Piping Systems.

.2 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Standpipe and Hose Systems.

1.4 SUBMITTALS

.1 Product Data:

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product data to include paint colour chips, other products specified in this section.

.3 Samples:

.1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.5 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

.2 Dispose of unused paint coating material at official hazardous material collections site approved by Owner's Representative.

.3 Do not dispose of unused paint coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

PART 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

.4 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # (mm)	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: Use size # 5.

.2 Equipment in Mechanical Rooms: Use size # 9.

.5 Identify equipment type and number (e.g. Hot Water Pump 1) and service or areas or zone of building served e.g. " Kettle Room 1 AHU-1".

.6 All plates shall be pop riveted in place.

.7 Fasten nameplates securely in conspicuous place.

.8 Submit list of nameplates for review prior to engraving.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Owner's Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES (NOT APPLICABLE)

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.3 For outside diameters up to 6" the markers shall be coiled and wrap completely around the pipe with six rows of wording in alternate directions.

.4 For outside diameters greater than 6" the markers shall be saddle style with two (2) rows of wording and shall be installed utilizing nylon cable ties provided with the marker.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Owner's Representative.

.2 Colours for legends, arrows, to following table:

Background colour	Legend, arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
City water	Green	CITY WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Boiler feed water	Yellow	BLR. FEED WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic hot water recirculation	Green	DOM. HW CIRC

Contents	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Domestic cold-water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

.3 Identify system: e.g. Supply AHU-1, Exhaust F-7.

.4 Maintain maximum 15m (50 ft) distance between markings.

.5 Identify ducts each side of dividing walls or partitions and beside each access door.

.6 Stencil over final finish only.

2.7 VALVES, CONTROLLERS

.1 Provide two-ply engraved laminated plastic tags.

.2 Provide Consultant with six (6) identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.

.3 Install where directed one (1) copy of flow diagram and valve schedule mounted in glazed frame. Provide one (1) copy in each operating and maintenance instruction manual.

.4 Consecutively number valves in systems.

.5 Mechanical Contractor shall coordinate the valve numbering system utilized for the new building with the Owner’s current valve numbering system.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in section 25 05 54 – EMCS: Identification. If no EMCS included in project, identification as per this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position, component ID name.

2.9 LANGUAGE

.1 Identification to be in English.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection

.1 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Owner’s Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.6 VAV AND REHEAT LOCATIONS

.1 Provide a blue round 20mm (3/4") sticker on the T-Bar grid at each location of VAV boxes or fan power boxes above the ceiling.

.2 Provide a red round 20mm (3/4") sticker on the T-bar grid at each location of reheat or heating coils above the ceiling.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this Section.

1.2 RELATED SECTIONS

.1 Section 21 05 00 – Common Work Results for Mechanical

1.3 REFERENCES

.1 AABC - Associated Air Balance Council

.2 ASHRAE - American Society of Heating Refrigerating & Air Conditioning Engineers

.3 NABC - National Air Balance Council

.4 SMACNA - Sheet Metal & Air Conditioning Contractors National Association

.5 NEBB – National Environmental Balancing Bureau

1.4 THE AIR AND HYDRONIC BALANCING CONTRACTOR SHALL BE ONE OF THE FOLLOWING:

.1 DASS Enterprises

.2 Design Test and Balance

.3 VPG

.4 Flowset

.5 Vital Canada Group

.6 Clark Balancing Ltd.

.7 Dynamic Flow Balancing Ltd.

1.5 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel certified to AABC, NEBB or SMACNA to perform TAB to Owner's Representative within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience. TAB contractor shall have a minimum of 5 (five) years experience to AABC, NEBB or SMACNA.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems – Testing, Adjusting and Balancing.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in the TAB standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures and requirements are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or SMACNA), requirements and recommendations contained in these procedures and requirements are mandatory.

1.6 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.7 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.8 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.9 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Owner's Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Owner's Representative in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.10 DIVISION 22 AND 23 ASSISTANCE

.1 The Division 22/23 Contractor shall provide the TAB Contractor all of the assistance which is required to complete the TAB Contractor's work. This shall include but not be limited to:

.1 Provision of all required shop drawings and fan and pump curves.

.2 Provision of all required test ports.

.3 All assistance required to balance variable speed systems in accordance with the design documents.

1.11 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in other Divisions.

1.12 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Owner's Representative for verification of TAB reports.

1.13 START OF TAB

.1 Notify the Consultant seven (7) working days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weatherstripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere in other Divisions.

.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.14 SYSTEMS TO BE TESTED

.1 Air Handling

.2 Hydronic Heating

.3 Exhaust Systems

1.15 LEAKAGE TESTING

.1 The Mechanical Contractor shall hire the TAB Contractor to complete leakage testing of ductwork.

1.16 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Laboratory HVAC systems: plus 10%, minus 0%.

.2 Other HVAC systems: plus 5%, minus 5%.

.3 Hydronic systems: plus or minus 10 %.

.4 Refrigeration systems: plus or minus 10%.

1.17 ACCURACY TOLERANCES

.1 Measured values to be accurate to within plus or minus 2 % of actual values.

1.18 INSTRUMENTS

.1 Prior to TAB, submit to Owner's Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 (three) months of TAB. Provide certificate of calibration to Owner's Representative.

1.19 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.20 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Owner's Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

.5 TAB air reports

.6 TAB hydronic reports

.7 TAB pressure testing reports.

1.21 TAB REPORT

.1 Format to be in accordance with referenced standard.

.2 TAB report to show results in units utilized on the drawings and to include:

.1 Air Systems

.1 Summary.

.2 Procedure.

.3 Instrumentation.

.4 Drawings.

.5 Equipment/Component Summary.

.6 Fan data sheets.

.7 Fan curves.

.8 Air handling unit profile data.

.9 Traverse data and schedule.

.10 Outlets data summary and schematic (per system).

.11 Diagnostics.

.2 Hydronic Systems

.1 Summary.

.2 Procedure.

.3 Instrumentation.

.4 Drawings.

.5 Equipment/Component Summary.

.6 Pump data sheets.

.7 Pump curves.

.8 Pump profile data.

.9 Balancing valve summary and schematic (per system).

.10 Coils (heating) per system.

.11 Diagnostics.

.3 Produce "as built" full system schematics and floor plans identifying the location where all measurements were taken and the resulting flows that were obtained. Use as built drawings for reference.

.4 Submit preliminary TAB reports in electronic format (PDF) for verification and approval of The Consultant.

.5 Submit final TAB reports in electronic format (PDF) after approval by the the Consultant.

.6 Obtain the shop drawing for each fan system. Mark the actual operating point on the fan curve for each fan. Include the fan curves for each fan in the balancing report.

.7 Obtain the shop drawing for each pump system. On the pump curve for each pump mark the actual operating point on the curve. Include the pump curves with superimposed power draw, rpm and impeller size.

1.22 VERIFICATION

.1 Reported results subject to verification by the Consultant.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 A measured flow deviation of more than 10 percent between the verification reading and the reported data shall be considered a failure of the verification procedure.

.4 A failure of more than 10-percent of the selected verification readings shall result in the rejection of the report as unacceptable.

.5 Should the report be rejected, the TAB Contractor shall rebalance all systems, submit new certified reports and make a re-inspection at no additional cost to the Owner.

.6 Number and location of verified results to be at discretion of the Consultant.

.7 Bear costs to repeat TAB as required to satisfaction of the Consultant.

1.23 SETTINGS

.1 After TAB is completed to satisfaction of Owner's Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

.3 The TAB Contractor shall setup ECM fans to deliver the required air flow.

1.24 COMPLETION OF TAB

.1 TAB to be considered complete when final TAB Report received and approved by the Consultant.

1.25 AIR SYSTEMS

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.

.2 Do TAB of systems, equipment, components, controls specified in other Divisions.

.3 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

.4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls:

.1 air velocity

.2 static pressure

.3 flow rate

.4 pressure drop (or loss)

.5 temperatures (dry bulb, wet bulb, dewpoint)

.6 duct cross-sectional area

.7 RPM

.8 electrical power

.1 voltage

.2 amperage

.9 noise

.10 vibration

.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of:

.1 Dampers

.2 filters

.3 coils

.4 fans

.5 Flow Station

.6 Any auxiliary equipment

.2 At controllers, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate:

.1 Main ducts

.2 main branch ducts

.3 sub-branch ducts

.4 All supply, exhaust and return air inlets and outlets

.5 All areas served by the system

.6 Before and after silencers

.7 Any auxiliary equipment

1.26 HYDRONIC SYSTEMS

.1 Definitions: for purposes of this section, to include low pressure hot water heating.

.2 Standard: TAB to be to most stringent of TAB standards of AABC or NEBB.

.3 Do TAB of systems, equipment, components, controls specified in other Divisions.

.4 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

.5 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls:

.1 flow rate

.2 pressure

.3 Pressure differential

.4 Temperature

.5 specific gravity

.6 RPM

.7 electrical power:

.1 voltage

.2 amperage

.8 noise

.9 vibration.

.7 Locations of equipment measurement: to include, but not be limited to, following as appropriate:

.1 Inlet and outlet of

.1 heat exchangers (primary and secondary sides)

.1 Temperatures entering and leaving

.2 Flow entering and leaving

.3 Differential pressure across entering and leaving

.2 boiler

.3 coils

.4 pumps

.5 PRVs

.6 control valves

.7 Manual Balancing Valves:

.1 Flow and setpoint at each balancing valve

.8 Automatic Balancing Valves:

.1 Pressure differential reading at each balancing valve to confirm that the pressure drop across the valve is within the acceptable range

.9 PICV (Pressure Independent Control Valves)

.1 Pressure drop and setpoint at PICV

.10 Meters

.1 Confirm the flow measured by meters matches the flows measured by the TAB Contractor.

.11 other equipment causing changes in conditions.

.2 At controllers, controlled device.

.8 Locations of systems measurements to include, but not be limited to, following as appropriate: supply and return of primary and secondary loops (main, main branch, branch, sub-branch) of all hydronic systems, inlet connection of make-up water.

1.27 DOMESTIC WATER SYSTEMS

.1 Meet requirements as specified for hydronic systems.

.2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.

.3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

1.28 OTHER SYSTEMS

.1 Plumbing systems:

.1 Standard: National Plumbing Code.

.2 TAB procedures:

.1 Flush valves: adjust to suit project pressure conditions.

.2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.

.3 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.

.4 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.

.5 Pressure reducing station.

.2 Chemical treatment systems:

.1 Standard: Section 23 25 00 – HVAC Water Treatment.

.2 TAB procedures: refer to Section 23 25 00 – HVAC Water Treatment.

.3 Balance bypass filter across pumps to required flow rate.

1.29 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter and summer design conditions.

.3 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.

.4 Measurement of spatial noise:

.1 Standard: Section 23 32 48 – Acoustical Air Plenums.

1.30 POST- OCCUPANCY TAB

.1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of areas designated by Owner's Representative.

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 3 months of termination of Warranty Period.

PART 2 Products (NOT applicable)

PART 3 Execution

3.1 GENERAL

.1 Balancing shall be carried out by an independent qualified balancing company. Balancing company must be one of the approved balancing companies outlined in this Section.

.2 Replace sheaves as required to balance systems to the indicated air volumes. Sheaves shall be provided at no additional cost to the Owner by the Division 22/23 Contractor.

.3 Division 22/23 Contractor to provide all required parts, belts and adjustments for all systems as deemed necessary to complete the required balancing.

.4 The Division 22/23 Contractor shall provide the required assistance to the TAB Contractor as deemed necessary by the Consultant.

.5 The TAB contractor shall visit the site in accordance with item 1.3 above.

.6 The TAB Contractor shall confirm that the flow stations provided in the supply, return and exhaust air ductwork are measuring accurate readings. The variable speed drive shall be adjusted to allow for measurements at 50%, 75% and 100% flow. The flow displayed by the flow stations shall be confirmed to be accurate. Provide in the balancing report the results of the three point calibration.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for ducting and ducting accessories for the following systems:

.1 Indoor, concealed supply and outdoor air.

.2 Indoor, exposed supply and outdoor air.

.3 Indoor, concealed return located in unconditioned space.

.4 Indoor, exposed return located in unconditioned space.

.5 Indoor, concealed, Type I, commercial, kitchen hood exhaust.

.6 Indoor, exposed, Type I, commercial, kitchen hood exhaust.

.7 Indoor, concealed exhaust between isolation damper and penetration of building exterior.

.8 Indoor, exposed exhaust between isolation damper and penetration of building exterior.

.9 Outdoor, concealed supply and return.

.10 Outdoor, exposed supply and return.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing

.3 Section 07 92 00 – Joint Sealants

.4 Section 23 05 53– Mechanical Identification.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547, Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.9 ASTM C921, Standard Practice for Determining Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.6 National Energy Code of Canada for Buildings (NECB)

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

1.5 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include plans, elevations, sections, details, and attachments to other work:

.1 Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

.2 Detail attachment and covering of heat tracing inside insulation.

.3 Detail insulation application at pipe expansion joints for each type of insulation.

.4 Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

.5 Detail removable insulation at piping specialties.

.6 Detail application of field-applied jackets.

.7 Detail application at linkages of control devices.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions to Owner’s Representative.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

.3 Surface Burning Characteristics:

.1 For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing and inspecting agency acceptable to authorities; having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

.1 Insulation Installed Indoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.

.2 Insulation Installed Outdoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Product Requirements.

.2 Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

.3 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.4 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Owner's Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Owner's Representative.

1.8 COORDINATION

.1 Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

.2 Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

.3 Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

.1 Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 Products

2.1 GENERAL

.1 Products shall not contain formaldehyde, asbestos, lead, mercury, or mercury compounds.

.2 Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.

.3 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

.4 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 **Type 1** – Blanket Insulation:

.1 Mineral fibre blanket composed of high-quality glass fibers bonded together with a thermosetting resin with factory applied foil-scrim-kraft (FSK) jacket.

.2 Comply with ASTM C 553, Types I, II, and III, ASTM C 1136 Type II, and ASTM C 1290, Type I. UL/ULC Classified FSK, FHC 25/50 per ASTM E 84 for PSK only. Nominal density is 0.75 lb/cu. ft. (12 kg/cu. m) or more.

.3 Thermal conductivity (k-value) at 75 deg F (24 deg C) is 0.27 Btu x in. /h x sq. ft. x deg F (0.039 W/m x C) or less.

.4 Standard of Acceptance: Knauf Atmosphere Duct Wrap, Manson, Johns Manville.

.2 **Type 2** – Rigid Board Insulation:

.1 Mineral fibre board insulation composed of high-quality glass fibers bonded together with a thermosetting resin with factory applied foil-scrim-kraft (FSK) jacket.

.2 UL/ULC Classified per UL 723 for unfaced, ASJ, ASJ+ and FSK; FHC 25/50 per ASTM E 84 for PSK only.

.3 Comply with ASTM C 612, Type IA or Type IB. UL GREENGUARD Gold and Verified by UL Environment to be formaldehyde free.

.4 Thermal conductivity (k-value) at 75 deg F (24 deg C) is 0.23 Btu x in. /h x sq. ft. x deg F (0.033 W/m x C) or less.

.5 For duct and plenum applications, provide insulation with factory-applied FSK jacket.

.6 Standard of Acceptance: Knauf Insulation Board, Manson, Johns Manville.

.3 **Type 3** – Duct Fire Wrap

.1 Fire Barrier Duct Wrap: Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 1.5 inches (38mm) for ventilation and grease duct applications.

.1 Color: White blanket, aluminum foil encapsulated.

.2 Weight: 0.9 psf (4.38 kg/m2).

.3 Density: 6 pcf nominal.

.4 Thermal Conductivity (k-value) at 500 Degrees F (260 Degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft2 × h × F) (0.07 W/(m × K)).

.5 R-Value per ASTM C 518 at ambient (77 F/ 25 C): at least 6.3 (F-ft2-hr / Btu)

.6 Service range up to 2000ºF (1093ºC)

.7 Fire Resistance: For use in 1 hour fire resistant systems. Confirm fire rating with Engineer.

.8 Fire Resistance: For use in 2 hour fire resistant systems. Confirm fire rating with Engineer.

.9 Product complies with ASTM E 2336 test standard.

.10 Product complies with ISO 6944 test standard.

.11 Through-penetration per ASTM E 814 (UL 1479)

.12 Non-combustible per ASTM E 136

.13 Standard of Acceptance: 3M 615

.2 Tape:

.1 High performance filament tape, 3M No. 898 1 inch (25mm) wide.

.2 FSK Facing Tape with aluminum foil, fiberglass scrim, kraft paper backing: nominal 3 inches (76mm) or 4 inches (102mm) wide (for sealing cut blanket edges and seams), 3M No. 3320.

.3 Banding Material: Stainless or carbon steel banding: 1/2 inch (13mm) wide X 0.015 inch (0.4mm) thick, as stated in duct wrap Design Listing.

.4 Insulation pins and clips:

.1 Copper-coated steel pins, 12 gauge with a minimum length of 4 inches (102mm) with square galvanized steel speed clips: 2.5 inch (64mm).

.2 12 gauge insulated cup head steel pins.

.5 Through-penetration firestop materials:

.1 Packing materials: Pieces of 3M Fire Barrier Duct Wrap, or 4 pcf mineral wool.

.2 Sealants: 3M Fire Barrier: 1000 NS non-slump silicone sealant, 1003 SL self-leveling silicone sealant, 2000+ premium non-slump silicone sealant, or CP 25WB+ premium intumescent latex caulk, as stated in firestop Design Listing.

2.4 ADHESIVES

.1 Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

.2 Mineral Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

.1 For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.3 ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

.1 For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.4 PVC Jacket Adhesive: Compatible with PVC jacket.

.1 For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.1 For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.2 Vapor Barrier Mastic: Water based; suitable for indoor use on below ambient services.

.1 Water Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.04 perm (0.026 metric perm) at 40 mil (1.016 mm) dry film thickness.

.2 Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

.3 Solids Content: ASTM D 1644, 52 percent by volume and 62 percent by weight.

.4 Color: White.

.3 Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

.1 Water Vapor Permeance: ASTM F 1249, 1.8 perm (1.2 metric perm) at 0.0625 inch (1.6 mm) dry film thickness.

.2 Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

.3 Solids Content: 50 percent by volume and 58 percent by weight.

.4 Color: White.

2.6 LAGGING ADHESIVES

.1 Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

.2 For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.3 Fire resistant, water-based lagging adhesive and coating for use indoors to adhere fire resistant lagging cloths over pipe insulation.

.4 Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

.5 Color: White.

2.7 SEALANTS

.1 FSK and Metal Jacket Flashing Sealants:

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.2 Fire and water resistant, flexible, elastomeric sealant.

.3 Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

.4 Color: Aluminum.

.5 For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.2 ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.2 Fire and water resistant, flexible, elastomeric sealant.

.3 Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

.4 Color: White.

.5 For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 FACTORY-APPLIED JACKETS

.1 Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

.1 FSK Jacket: Aluminum foil, fiberglass reinforced scrim with kraft paper backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED JACKETS

.1 Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

.2 FSK Jacket: Aluminum foil face, fiberglass reinforced scrim with kraft paper backing.

.3 Woven Glass Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz. /sq. yd. (271 g/sq. m).

.4 Woven Glass Fiber Fabric: Approximately 2 oz. /sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

.5 Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

.6 PVC Jacket: High impact resistant, UV resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

.1 Adhesive: As recommended by jacket material manufacturer.

.2 Color: White

.7 Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

.1 Shapes: 45 and 90 degree, short and long radius elbows, tees, valves, flanges, unions, reducers, end caps, soil pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

.8 Metal Jacket:

.1 Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

.2 Factory cut and rolled to size.

.3 Finish and thickness are indicated in field-applied jacket schedules.

.4 Moisture Barrier for Outdoor Applications: 3 mil (0.075 mm) thick, heat bonded polyethylene and kraft paper

.5 Factory-Fabricated Fitting Covers:

.1 Same material, finish, and thickness as jacket.

.2 Preformed 2 piece or gore, 45 and 90 degree, short and long radius elbows.

.3 Tee covers.

.4 Flange and union cover.

.5 End caps.

.6 Beveled collars.

.7 Valve covers.

.8 Field-fabricate fitting covers only if factory-fabricated fitting covers are not available.

.9 Stainless Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

.1 cut and rolled to size.

.2 Material, finish, and thickness are indicated in field-applied jacket schedules.

.3 Moisture Barrier for Indoor Applications: 1mil (0.025 mm) thick, heat bonded polyethylene and kraft paper

.4 Moisture Barrier for Outdoor Applications: 3 mil (0.075 mm) thick, heat bonded polyethylene and kraft paper

.5 Factory-Fabricated Fitting Covers:

.1 Same material, finish, and thickness as jacket.

.2 Preformed 2 piece or gore, 45 and 90 degree, short and long radius elbows.

.3 Tee covers.

.4 Flange and union covers.

.5 End caps.

.6 Beveled collars.

.7 Valve covers.

.8 Field-fabricate fitting covers only if factory-fabricated fitting covers are not available.

.10 Self-Adhesive Outdoor Jacket: 60 mil (1.5 mm) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with white aluminum foil facing.

2.10 TAPES

.1 FSK Tape: Foil face, vapor retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

.1 Width: 3 inches (75 mm) or 4 inches (102 mm).

.2 Thickness Total: 13.3 mil (0.34 mm).

.3 Adhesion: 90 ounces force/inch (1.0 N/mm), in width.

.4 Elongation: 2 percent.

.5 Tensile Strength: 40 lbf/inch (7.2 N/mm), in width.

.6 FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.11 SECUREMENTS

.1 Bands:

.1 Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.

.2 Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

.2 Staples: Outward clinching insulation staples, nominal ¾ inch (19 mm) wide, stainless steel or Monel.

.3 Wire: 0.062 inch (1.6 mm) soft annealed, stainless steel.

2.12 INSULATION PINS AND HANGERS:

.1 Capacitor Discharge Weld Pins: Copper or zinc coated steel pin, fully annealed for capacitor discharge welding, 0.106 inch (2.6 mm) diameter shank, length to suit depth of insulation indicated.

.2 Cupped Head, Capacitor Discharge Weld Pins: Copper or zinc coated steel pin, fully annealed for capacitor discharge welding, 0.106 inch (2.6 mm) diameter shank, length to suit depth of insulation indicated with integral 1-1/2 inch (38 mm) galvanized carbon steel washer.

.3 Metal, Adhesively Attached, Perforated Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated; securely in position indicated when self-locking washer is in place. Comply with the following requirements:

.1 Baseplate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

.2 Spindle: Copper or zinc coated, low carbon steel fully annealed, 0.106 inch (2.6 mm) diameter shank, length to suit depth of insulation indicated.

.3 Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

.4 Nonmetal, Adhesively Attached, Perforated Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated; securely in position indicated when self-locking washer is in place. Comply with the following requirements:

.1 Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

.2 Spindle: Nylon, 0.106 inch (2.6 mm) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

.3 Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

.5 Self-Sticking Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated; securely in position indicated when self-locking washer is in place. Comply with the following requirements:

.1 Baseplate: Galvanized carbon steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

.2 Spindle: Copper or zinc coated, low carbon steel, fully annealed, 0.106 inch (2.6 mm) diameter shank, length to suit depth of insulation indicated.

.3 Adhesive backed base with a peel off protective cover.

.6 Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick, galvanized steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

.1 Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

.7 Nonmetal Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

2.13 CORNER ANGLES

.1 Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

.2 Stainless Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 Execution

3.1 MANUFACTURE'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE- INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.3 INSTALLATION

.1 General:

.1 Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

.2 Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

.3 Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

.4 Install insulation with longitudinal seams at top and bottom of horizontal runs.

.5 Install multiple layers of insulation with longitudinal and end seams staggered.

.6 Keep insulation materials dry during application and finishing.

.7 Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

.8 Install insulation with least number of joints practical.

.9 Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor barrier mastic.

.1 Install insulation continuously through hangers and around anchor attachments.

.2 For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor barrier mastic.

.3 Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

.10 Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

.11 Install insulation with non-self-sealing factory-applied jackets as follows:

.1 Draw jacket tight and smooth.

.2 Cover circumferential joints with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) oc.

.3 Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive longitudinal lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm)

.1 For below ambient services, apply vapor barrier mastic over staples.

.4 Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

.5 Where vapor barriers are indicated, apply vapor barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

.12 Install insulation with self-sealing factory-applied jackets as follows:

.1 Locate all longitudinal duct insulation jacketing laps in least visible location.

.2 Draw jacket tight and smooth.

.3 For proper sealing, seal lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool.

.4 Vapor seal all circumferential joints with factory furnished matching pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool.

.13 Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

.14 Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

.15 Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

.2 Type 1 - Blanket Insulation Installation on Ducts and Plenums

.1 Secure with insulation pins.

.2 Install either capacitor discharge weld pins and speed washers or cupped head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

.1 On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) oc.

.2 On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) oc. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

.3 Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

.4 Do not over compress insulation during installation; maximum 25 percent compression.

.5 Impale insulation over pins and attach speed washers.

.6 Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

.7 Pressure sensitive foil tapes shall be a minimum 3” wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool.

.3 Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) oc.

.4 Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat oval duct elbows with individually mitered gores cut to fit the elbow.

.5 Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6 inch (150 mm) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) oc.

.3 Type 2 - Board Insulation Installation on Ducts and Plenums

.1 Secure with insulation pins.

.2 Install either capacitor discharge weld pins and speed washers or cupped head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

.1 Apply insulation with joints butted as close as possible to the duct surface.

.2 On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) oc.

.3 On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) oc. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

.4 Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

.5 Do not over compress insulation during installation.

.6 Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

.7 All joints shall be sealed using minimum 3 inch wide pressure sensitive, acrylic based tape; matching the facing. Tape shall be firmly rubbed; using a plastic squeegee or sealing tool to assure complete bond.

.4 Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat oval duct elbows with individually mitered gores cut to fit the elbow.

.5 Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6 inch (150 mm) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) oc.

.6 Type 3 – Fire Wrap Insulation Installation

.1 General

.1 Install in strict accordance with manufacturer's detailed installation instructions and procedures.

.2 Install so that openings are completely filled and material is securely adhered.

.3 Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.

.4 After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.

.5 Repair or replace defective installations to comply with requirements.

.6 At each through penetration, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.

.7 Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.

.8 Notify authority having jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.

.9 Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

.2 Fire Rated Duct Wrap Insulation (1 and 2 HR Enclosures)

.1 Kitchen Exhaust Grease Ducts: Install fire resistive duct wrap insulation in direct contact with ductwork to Manufacturer's instructions and referenced standards, to applicable Omega Point Laboratories design numbers, including listed penetration firestop system.

.1 For kitchen exhaust grease ducts, regardless of fire rating, provide two layers of 3M Fire Barrier Duct Wrap 615+ per layer with 3 inch (76mm) overlaps.

.2 Kitchen Exhaust Ductwork: Overlap perimeter and longitudinal joints 3 inches (76mm) or 3 inches (76mm) on both layers. If required, tape seams using minimum 3 inch (76mm) wide aluminium foil adhesive tape.

.3 Ventilation Air Ducts (1 and 2 hr. Enclosure): Install fire resistive duct wrap insulation in direct contact with ductwork to Manufacturer's instructions and referenced standards, including Listed penetration firestop system.

.4 Apply fire resistive duct wrap insulation continuously to ductwork as indicated on Drawings. For ventilation air ducts, provide one layer of 3M Fire Barrier Duct Wrap 615+ with 3 inch (76mm) overlaps for 1 and 2 hour applications. Observe requirements for additional duct wrap material required at firestop, when required.

.5 Ventilation Ductwork (1 and 2 hr. applications): overlap perimeter and longitudinal joints 3 inches (76mm). If required, tape seams using minimum 3 inch (76mm) wide aluminium foil adhesive tape.

.6 Filament tape may be used as a temporary securing measure during application of duct wrap. Finish installation using 1/2 inch (13mm) wide by 0.015 inch (0.4mm) steel banding on exterior layer of wrap. Spacing 10.5 inches (267mm) on center and within 1.5 inches (39mm) of all overlapped seams. Consult individual listings for approved banding type.

.7 Duct Widths Greater than 24 Inches (610mm): Weld insulation pins to bottom of horizontal ducts on a 12 inch (305mm) by 10.5 inch (267mm) maximum grid spacing. Welded insulation pins to one of the wider sides of all vertical ducts on a 12 inch (305mm) by 10.5 inch (267mm) maximum grid spacing. Impale duct wrap insulation over pins and secure with speed clips.

.8 Duct Access Doors: Install duct wrap to Manufacturer's instructions and procedures.

.9 Firestopping At Fire Separations:

.1 Firestop all wrapped ductwork penetrating fire rated concrete floors, gypsum board, block and concrete wall assemblies and gypsum board shaftwall assemblies using UL and/or Omega Point Laboratories firestop system Listings appropriate for the applicable duct wrap system .

.2 Kitchen exhaust grease ducts: Fire resistive duct wrap insulation to be continuous through wall or floor penetrations. Minimum 0.5 inch (13mm), maximum 4.5 inch (114mm) clearance permitted between outer layer of duct wrap insulation and edge of opening. Fill annular space between edge of opening and wrapped duct with pieces of 3M duct wrap insulation or mineral wool insulation firmly packed into opening. Compress to percentage stated and minimum depth stated in firestop listing. Recess packing material below surface on both sides of walls or top side only for floors to depth stated in firestop listing. Seal over packing material using 3M

firestop sealant to depth stated in firestop listing, flush with top side of floor and both sides of wall surfaces.

.10 Ventilation ducts: Fire resistive insulation may pass continuously through fire rated wall or floor penetrations or may tightly butt to both sides of fire rated separations. Minimum 1 inch (25mm), maximum 3 inch (76mm) clearance permitted around unwrapped duct in opening or from edge of opening to outer layer of duct wrap. Consult individual Listed firestop systems for specific requirements.

.1 Option A: Terminate wrap at fire separation. Fill space around unwrapped duct where it passes through a fire rated wall or floor with pieces of 3M duct wrap insulation or mineral wool insulation firmly packed into opening. Compress to the percentage stated in the firestop listing to full depth of floor or wall. Recess packing on both sides of walls or top side of floor to depth stated in firestop listing. Seal over packing material using 3M firestop sealant to depth stated in firestop listing, flush with top side of floor and both sides of wall surfaces. Tightly butt fire resistive duct wrap insulation to each side of wall or floor assembly and seal interface with a continuous bead of 3M firestop sealant.

.2 Option B: Wrap continuous through fire separation. Fill space around continuously wrapped duct where it passes through fire rated wall or floor with pieces of 3M duct wrap insulation or mineral wool insulation firmly packed into opening and compress to the percentage stated in the firestop listing to a minimum depth of 4". Recess packing material below surface on both sides of wall or top side of floor to depth stated in firestop listing. Seal over packing material using 3M firestop sealant to depth stated in firestop listing, flush with top side of floor and both sides of wall surfaces.

.11 Where kitchen exhaust hoods are located within a fire rated area or zone, begin application of duct wrap insulation inside fire rated area 6 inches (152mm) from face of fire rated wall or ceiling assembly for non-combustible fire separations, and 18 inches (457mm) from face of wall or ceiling surface inside fire rated area for combustible fire separations, or as indicated on the Drawings. Apply two layers of duct wrap continuously to ductwork through fire separation for distance indicated on the Drawings.

.7 Penetrations:

.1 Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

.1 Seal penetrations with flashing sealant.

.2 For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

.3 Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

.4 Seal jacket to roof flashing with flashing sealant.

.2 Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

.1 Seal penetrations with flashing sealant.

.2 For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

.3 Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

.4 Seal jacket to wall flashing with flashing sealant.

.3 Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

.4 Insulation Installation at Fire Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire rated walls and partitions.

.1 Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire resistive joint sealers.

.5 Insulation Installation at Floor Penetrations:

.1 Duct: For penetrations through fire rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).

.2 Seal penetrations through fire rated assemblies. Comply with requirements in Section 078413 "Penetration Fire-stopping."

.8 Field Applied Jackets:

.1 Where glass cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

.1 Draw jacket smooth and tight to surface with 2 inch (50 mm) overlap at seams and joints.

.2 Embed glass cloth between two 0.062 inch (1.6 mm) thick coats of lagging adhesive.

.3 Completely encapsulate insulation with coating, leaving no exposed insulation.

.2 Where FSK jackets are indicated, install as follows:

.1 Draw jacket material smooth and tight.

.2 Install lap or joint strips with same material as jacket.

.3 Secure jacket to insulation with manufacturer's recommended adhesive.

.4 Install jacket with 1-1/2 inch (38 mm) laps at longitudinal seams and 3 inch (75 mm) wide joint strips at end joints.

.5 Seal openings, punctures, and breaks in vapor retarder jackets and exposed insulation with vapor barrier mastic.

.3 Where PVC jackets are indicated, install with minimum 1 inch (25 mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

.1 Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

.4 Where metal jackets are indicated, install with minimum 2 inch (50 mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) oc. and at end joints.

.5 Where Laminated Self-Adhesive Water and Weather Seals are indicated, install in strict compliance with manufacturer's recommended installation procedures.

3.4 DUCT INSULATION SCHEDULES

.1 Conform to the following table

Insulation Type and Thickness Schedule

Application	Extent	Operating Temperature F (C)	Insulation Thickness	Type
Outside Air Intake	Outside air plenum and all ductwork up to mixing box. This includes all outside air ductwork from the point that it enters the building to the air handling units.	-40 to 90°F (-40 to 32.2C)	2" 50 mm 3” 75mm	Type 2 Type 1
Ductwork Exterior to the Building	All Ductwork installed exterior to the building.	-40 to 90°F (-40 to 32.2C)	3" 75 mm 4.5” 112mm	Type 2 Type 1
Exhaust Air Discharge	From wall/roof penetration to 10 feet from exterior. Terminate at fan if fan closer than 10 feet. Include the exhaust air plenum.	-40 to 80 F (-40 to 26.7 C)	2" 50 mm 3” 75mm	Type 2 Type 1
Exhaust Air Discharge From Heat Recovery Unit	From discharge of unit to wall/roof penetration including the exhaust air plenum.	-40 to 50°F (-40 to 10 C)	2" 50 mm 3” 75mm	Type 2 Type 1

Supply Air	From supply fan discharge to diffuser/grille. This includes all supply air ductwork from outside air make up units to other air handling units.	50°F to 149°F (10 C to 65 C)	1" 25 mm 1.5” 38mm	Type 2 Type 1
Silencers	Insulate all supply air silencers.	50°F to 149°F 10 C to 65 C	1" 25 mm 1.5” 38mm	Type 2 Type 1
Return Air	Required for ductwork exterior to the building and ductwork passing through unheated spaces where the temperature will be below 40°F (4.4 C). All other return air ductwork does not require insulation.	65°F to 90°F (18 C to 32 C)	2" 50 mm 3” 75mm	Type 2 Type 1
Blanked Off Louvres	Entire Surface	-40 to 50°F (-40 to 10 C)	2" 50 mm	Type 2
Explosion Vent from Dust Collector	From dust collector to exterior wall.	50°F to 149°F (10 C to 65 C)	1” 25mm 1.5” 38mm	Type 2 Type 1

Comments:

Where insulation is installed on ductwork having flanged connections, increase duct insulation as required to provide a 1/2" (12 mm) cover on flanges and duct angles.

Utilize rigid board insulation for thicknesses greater than 1" on rectangular ducts.

For ductwork exposed to the outdoors the top section of the insulation **shall be sloped** to ensure positive drainage from the top of the duct.

Return ductwork running through a heated space does not require insulation.

Ductwork that is internally lined with the required thickness of insulation is not required to be externally insulated.

3.5 FINISHES (JACKETING):

.1 Conform to following table:

Location	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	PVC	PVC
Indoor, exposed elsewhere	PVC Canvas where it is intended to be painted.	PVC Canvas where it is intended to be painted.
Outdoor, exposed to precipitation	Vapour Mastic with Metal Jacket	Vapour Mastic with Metal Jacket
Outdoor, elsewhere	Vapour Mastic with Metal Jacket	Vapour Mastic with Metal Jacket

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories for the following systems:

.1 Condensate drain piping, indoors and outdoors.

.2 Heating hot water piping, indoors and outdoors.

.3 Refrigerant suction and hot gas piping, indoors and outdoors.

.4 Domestic water plumbing piping systems (potable and non-potable including grey water systems).

.5 Storm drainage piping systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing

.3 Section 07 92 00 – Joint Sealants.

.4 Section 23 07 13 – Duct Insulation

.5 Section 23 05 53 – Mechanical Identification.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings (Including all Addenda).

.2 American Society for Testing and Materials (ASTM)

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533 Standard specification for Calcium Silicate Insulation Block and Pipe.

.6 ASTM C547 Standard Specification for Mineral Fibre Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.9 ASTM D1784, Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), c. 37.

.2 Canadian Environmental Protection Act, (CEPA), c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets.

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.8 National Energy Code of Canada for Buildings (NECB).

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

1.5 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include plans, elevations, sections, details, and attachments to other work:

.1 Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

.2 Detail attachment and covering of heat tracing inside insulation.

.3 Detail insulation application at pipe expansion joints for each type of insulation.

.4 Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

.5 Detail removable insulation at piping specialties.

.6 Detail application of field-applied jackets.

.7 Detail application at linkages of control devices.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions to Owner's Representative.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

.3 Surface Burning Characteristics:

.1 For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing and inspecting agency acceptable to authorities; having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

.1 Insulation Installed Indoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.

.2 Insulation Installed Outdoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Product Requirements.

.2 Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

.3 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.4 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Owner's Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Owner's Representative.

1.8 COORDINATION

.1 Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

.2 Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

.3 Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

.1 Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 PRODUCTS

2.1 GENERAL

.1 Products shall not contain formaldehyde, asbestos, lead, mercury, or mercury compounds.

.2 Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.

.3 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 **Type 1** – Preformed Pipe Insulation:

.1 Preformed insulation composed of high-quality glass fibers bonded together with a thermosetting resin with all service vapor retarder jacket (ASJ).

.2 Factory-applied pressure sensitive self-sealing lap closure system (SSL) with butt strips.

.3 Type I: 850 deg F (454 deg C) or Type IV: 1000 deg F (528 deg C).

.4 EPD Certified by UL Environment, UL/ULC Classified, FHC 25/50 per ASTM E 84.

.5 Comply with ASTM C 585, ASTM C 411, ASTM C795, and ASTM C 547, Type I or Type IV.

.6 Maximum "k" factor: 0.034 W/m C at 24 C (0.23 Btu in / (hr ft2 F) at 75 F) max to ASTM C518 and CAN/ULC S702.

.7 Insulation system shall be GREENGUARD GOLD Certified and have a Minimum total product recycled content of 28%.

.8 Standard of Acceptance: Manson Alley-K, Knauf, Johns Manville

.2 **Type 2** – Blanket Insulation:

.1 Semi-rigid fiberglass blanket composed of high-quality glass fibers bonded together with a thermosetting resin. 2.5 PCF (40 kg/m3) density in roll form complete with factory applied all service vapor retarder jacket (ASJ).

.2 Comply with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB.

.3 Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more.

.4 Thermal conductivity (k-value) at 75 deg F (24 deg C) is 0.24 Btu x in. /h x sq. ft. x deg F (0.035 W/m x C) or less.

.5 Insulation shall be made by at least 25% post-consumer content (certification by SCS Global Services).

.6 Standard of Acceptance: Manson AK Flex, Knauf, Johns Manville

.3 **Type 3** – Flexible Elastomeric Thermal Insulation:

.1 Flexible elastomeric in tubular form

.2 Product shall meet the requirements defined in ASTM C534, Grade 1, Type I, Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in sheet and Tubular Form.

.3 Materials shall have a flame spread index of less than 25 and smoke developed index of less than 50 when tested in accordance with ASTM E84.

.4 Materials shall have a maximum thermal conductivity of 0.27 Btu x in. /h x sq. ft. x deg F (0.042 W/m x C) at 75F mean temperature when tested in accordance with ASTM C177 or ASTM C518.

.5 Adhesive shall be the insulation manufacturers recommended contact adhesive: Armaflex 520.

.6 Insulation finish shall be the insulation manufacturers recommended finish: WB Armaflex Finish.

.7 Standard of Acceptance: Armaflex, Johns Manville.

2.4 ADHESIVES

.1 Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

.2 Mineral Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

.3 ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

.1 For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.4 PVC Jacket Adhesive: Compatible with PVC jacket.

.1 For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.1 For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.2 Vapor Barrier Mastic: Water based; suitable for indoor use on below ambient services.

.1 Water Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.04 perm (0.026 metric perm) at 40 mil (1.016 mm) dry film thickness.

.2 Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

.3 Solids Content: ASTM D 1644, 52 percent by volume and 62 percent by weight.

.4 Color: White.

.3 Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

.1 Water Vapor Permeance: ASTM F 1249, 1.8 perm (1.2 metric perm) at 0.0625 inch (1.6 mm) dry film thickness.

.2 Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

.3 Solids Content: 50 percent by volume and 58 percent by weight.

.4 Color: White.

2.6 LAGGING ADHESIVES

.1 Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

.2 For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.3 Fire resistant, water-based lagging adhesive and coating for use indoors to adhere fire resistant lagging cloths over pipe insulation.

.4 Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

.5 Color: White.

2.7 SEALANTS

.1 Joint Sealants:

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.2 Permanently flexible, elastomeric sealant.

.3 Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).

.4 Color: White or gray.

.5 For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.2 FSK and Metal Jacket Flashing Sealants:

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.2 Fire and water resistant, flexible, elastomeric sealant.

.3 Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

.4 Color: Aluminum.

.5 For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.3 ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

.1 Materials shall be compatible with insulation materials, jackets, and substrates.

.2 Fire and water resistant, flexible, elastomeric sealant.

.3 Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

.4 Color: White.

.5 For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 FACTORY-APPLIED JACKETS

.1 ASJ+ - SSL+; ASJ+ jacket with Self-Sealing Advanced Closure System; complying with ASTM C 1136 Type I, II, III, IV and VII secured with self-sealing longitudinal laps and matching ASJ+ butt strips.

.2 All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C 1136 Type I, II, III, IV and VII.

.3 ASJ: White, kraft paper, fiberglass reinforced scrim with aluminum foil backing; complying with ASTM C 1136, Type I.

.4 ASJ-SSL: ASJ with self-sealing, pressure sensitive, acrylic based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

.5 FSK Jacket: Aluminum foil, fiberglass reinforced scrim with kraft paper backing; complying with ASTM C 1136, Type II.

.6 PSK Jacket: Aluminum foil, fiberglass reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED JACKETS

.1 Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

.2 FSK Jacket: Aluminum foil face, fiberglass reinforced scrim with kraft paper backing.

.3 Woven Glass Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz. /sq. yd. (271 g/sq. m).

.4 Woven Glass Fiber Fabric: Approximately 2 oz. /sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

.5 Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

.6 PVC Jacket: High impact resistant, UV resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

.1 Adhesive: As recommended by jacket material manufacturer.

.2 Color: White

.7 Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

.1 Shapes: 45 and 90 degree, short and long radius elbows, tees, valves, flanges, unions, reducers, end caps, soil pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

.8 Metal Jacket:

.1 Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

.2 Factory cut and rolled to size.

.3 Finish and thickness are indicated in field-applied jacket schedules.

.4 Moisture Barrier for Outdoor Applications: 3 mil (0.075 mm) thick, heat bonded polyethylene and kraft paper

.5 Factory-Fabricated Fitting Covers:

.1 Same material, finish, and thickness as jacket.

.2 Preformed 2 piece or gore, 45 and 90 degree, short and long radius elbows.

.3 Tee covers.

.4 Flange and union cover.

.5 End caps.

.6 Beveled collars.

.7 Valve covers.

.8 Field-fabricate fitting covers only if factory-fabricated fitting covers are not available.

.9 Stainless Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

.1 cut and rolled to size.

.2 Material, finish, and thickness are indicated in field-applied jacket schedules.

.3 Moisture Barrier for Indoor Applications: 1mil (0.025 mm) thick, heat bonded polyethylene and kraft paper

.4 Moisture Barrier for Outdoor Applications: 3 mil (0.075 mm) thick, heat bonded polyethylene and kraft paper

.5 Factory-Fabricated Fitting Covers:

.1 Same material, finish, and thickness as jacket.

.2 Preformed 2 piece or gore, 45 and 90 degree, short and long radius elbows.

.3 Tee covers.

.4 Flange and union covers.

.5 End caps.

.6 Beveled collars.

.7 Valve covers.

.8 Field-fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

.1 ASJ Tape: White vapor retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

.1 Width: 3 inches (75 mm) or 4 inches (102 mm).

.2 Thickness Total: 14.3 mil (0.36 mm) for ASJ

.3 Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

.4 Elongation: 2 percent.

.5 Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

.6 ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

.2 FSK Tape: Foil face, vapor retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

.1 Width: 3 inches (75 mm) or 4 inches (102 mm).

.2 Thickness Total: 13.3 mil (0.34 mm).

.3 Adhesion: 90 ounces force/inch (1.0 N/mm), in width.

.4 Elongation: 2 percent.

.5 Tensile Strength: 40 lbf/inch (7.2 N/mm), in width.

.6 FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

.3 PVC Tape: White vapor retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

.1 Width: 2 inches (50 mm).

.2 Thickness: 6 mil (0.15 mm).

.3 Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

.4 Elongation: 500 percent.

.5 Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

2.11 SECUREMENTS

.1 Bands:

.1 Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.

.2 Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

.2 Staples: Outward clinching insulation staples, nominal ¾ inch (19 mm) wide, stainless steel or Monel.

.3 Wire: 0.062 inch (1.6 mm) soft annealed, stainless steel

2.12 INSULATING CEMENTS

.1 Mineral Fiber Insulating Cement: Comply with ASTM C 195.

.2 Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

.3 Mineral Fiber, Hydraulic Setting Insulating and Finishing Cement: Comply with ASTM C 449.

PART 3 EXECUTION

3.1 MANUFACTURE'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE- INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.3 INSTALLATION

.1 General:

.1 Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

.2 Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

.3 Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

.4 Install insulation with longitudinal seams at top and bottom of horizontal runs.

.5 Install multiple layers of insulation with longitudinal and end seams staggered.

.6 Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

.7 Keep insulation materials dry during application and finishing.

.8 Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

.9 Install insulation with least number of joints practical.

.10 Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor barrier mastic.

.1 Install insulation continuously through hangers and around anchor attachments.

.2 For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor barrier mastic.

.3 Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

.4 Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

.11 Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

.12 Install insulation with non-self-sealing factory-applied jackets as follows:

.1 Draw jacket tight and smooth.

.2 Cover circumferential joints with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) oc.

.3 Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive longitudinal lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm)

.1 For below ambient services, apply vapor barrier mastic over staples.

.4 Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

.5 Where vapor barriers are indicated, apply vapor barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

.13 Install insulation with self-sealing factory-applied jackets as follows:

.1 Locate all longitudinal pipe insulation jacketing laps in least visible location.

.2 Draw jacket tight and smooth.

.3 For proper sealing, seal lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool.

.4 Vapor seal all circumferential joints with factory furnished matching pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool.

.14 Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

.15 Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

.16 Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

.17 For above ambient services, do not install insulation to the following:

.1 Vibration control devices.

.2 Testing agency labels and stamps.

.3 Nameplates and data plates.

.4 Manholes.

.5 Handholes.

.6 Cleanouts.

.2 Type 1 and 2 Insulation:

.1 Insulation Installation on Straight Pipes and Tubes.

.1 Secure pipe insulation to pipe using self-sealing lap system.

.2 On high temperature piping, above 500 deg F (260 deg C), apply insulation using double layer and staggered joints. For double layer installation, secure the unjacketed inner layer using filament tape; without deforming insulation material. All joints and ends

must be firmly butted and secured with appropriate securing material.

.3 Firmly rub all longitudinal and circumferential joints using a squeegee or sealing tool.

.4 Longitudinal jacket laps for pipe insulation installed on piping systems with operating temperatures below ambient shall be vapor sealed with factory-applied pressure-sensitive adhesive vapor retarder, self-sealing lap. For proper sealing, firmly rub lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool. Vapor seal all circumferential joints with factory-furnished, matching pressure-sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool. Additionally, coat raw edges of pipe insulation sections with vapor retarder mastic at 12 foot (3.6 m) to 21 foot (6.4 m) intervals; at Engineer's discretion on straight piping, and on either side of all fittings, flanges, or valves. Vapor retarder mastic shall completely coat the ends of the pipe and extend onto the bore of the pipe insulation and onto the jacketing a minimum of 2 inches (51 mm).

.5 Install metal shields between hangers or supports and the pipe insulation. Install rigid insulation inserts as required between the pipe and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation, and shall be vapor sealed as required. Insulation shields shall be no less than the following lengths:

.1 1-1/2 inch (38 mm) to 2-1/2 inch (64 mm) IPS: 10 inch (254 mm) long.

.2 3 inch (76 mm) to 6 inch (152 mm) IPS: 12 inch (305 mm) long.

.3 8 inch (203 mm) to 10 inch (254 mm) IPS: 16 inch (406 mm) long.

.4 12 inch (305 mm) and over IPS: 22 inch (559 mm).

.6 For piping subject to abuse in mechanical rooms or high traffic areas, protect insulation from mechanical abuse by the use of appropriate thickness of PVC jacketing, metal jacketing, or laminated self-adhesive water and weather seal.

.7 Insulation Installation for Pipe Flanges:

.1 Install preformed pipe insulation to outer diameter of pipe flange.

.2 Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

.3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with Glass Mineral Wool blanket insulation.

.4 Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

.8 Insulation Installation on Pipe Fittings and Elbows:

.1 Install preformed formaldehyde free Glass Mineral Wool fittings; of same material as straight segments of pipe insulation when available.

.2 When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

.9 Insulation Installation on Valves and Pipe Specialties:

.1 Install preformed formaldehyde free fittings; of same material as straight segments of pipe insulation when available.

.2 When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to valve body.

.3 Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

.4 Install insulation to flanges as specified for flange insulation application.

.3 Type 3 Insulation:

.1 Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unsplit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armaflex 520 or 520 BLV Adhesive. A thin coat of adhesive must be applied to both surfaces, allowed to tack and join both surfaces with firm pressure.

.2 The insulation must be installed in compression to allow for expansion and contraction. Install an additional 1.5 inches of insulation for every six feet of installed pipe or an additional 2 percent of measured pipe length.

.3 Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

.4 Tape the ends of the copper tubing before slipping the Armaflex pipe insulation over the new pipes to prevent dust from entering the pipe.

.5 All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives must be used.

.6 On heat traced systems, the tracer shall not exceed the allowable temperature limit of the insulation material. Insulation ID may need to be oversized to accommodate heat trace tape.

.7 Seams shall be staggered when applying multiple layers of insulation.

.8 All outdoor exposed piping shall be painted with two coats of WB Armaflex Finish. Prior to applying the Finish, the insulation shall be wiped clean with denatured alcohol. The Finish shall not be tinted. To ensure good adhesion, the temperature should be above 50 °F during application and drying.

.9 All outdoor exposed piping shall have the seams located on the lower half of the pipe.

.10 As an alternative to WB Armaflex Finish, metal or aluminum jacketing may be used and should be applied according to the manufacturer's recommendations.

.4 Penetrations:

.1 Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

.1 Seal penetrations with flashing sealant.

.2 For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

.3 Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

.4 Seal jacket to roof flashing with flashing sealant.

.2 Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

.3 Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

.1 Seal penetrations with flashing sealant.

.2 For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

.3 Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

.4 Seal jacket to wall flashing with flashing sealant.

.4 Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

.5 Insulation Installation at Fire Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire rated walls and partitions.

.1 Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire resistive joint sealers.

.6 Insulation Installation at Floor Penetrations:

.1 Pipe: Install insulation continuously through floor penetrations.

.2 Seal penetrations through fire rated assemblies. Comply with requirements in Section 07 84 13, Penetration Fire-stopping.

.5 Field Applied Jackets:

.1 Where glass cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

.1 Draw jacket smooth and tight to surface with 2 inch (50 mm) overlap at seams and joints.

.2 Embed glass cloth between two 0.062 inch (1.6 mm) thick coats of lagging adhesive.

.3 Completely encapsulate insulation with coating, leaving no exposed insulation.

.2 Where FSK jackets are indicated, install as follows:

.1 Draw jacket material smooth and tight.

.2 Install lap or joint strips with same material as jacket.

.3 Secure jacket to insulation with manufacturer's recommended adhesive.

.4 Install jacket with 1-1/2 inch (38 mm) laps at longitudinal seams and 3 inch (75 mm) wide joint strips at end joints.

.5 Seal openings, punctures, and breaks in vapor retarder jackets and exposed insulation with vapor barrier mastic.

.3 Where PVC jackets are indicated, install with minimum 1 inch (25 mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

.1 Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

.4 Where metal jackets are indicated, install with minimum 2 inch (50 mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) oc. and at end joints.

.5 Where Laminated Self-Adhesive Water and Weather Seals are indicated, install in strict compliance with manufacturer's recommended installation procedures.

.6 Finishes:

.1 Pipe Insulation with ASJ+, ASJ, Glass Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below. NOTE: Painting MAY affect the FHC Classification of the Jacketing material.

.2 Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

.3 Finish Coat Material: Interior, flat, latex emulsion size.

.4 Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

.5 Do not field paint aluminum or stainless-steel jackets.

3.4 PIPING INSULATION SCHEDULES

.1 General

.1 Storm Water shall be provided with Type 1 Insulation for the piping and Type 2 insulation for the roof drain body.

.1 Horizontal and vertical runs of storm piping for 33' (10 m) from roof drain.

.2 Where multiple storm drain runouts are shorter than 33' (10 m) connect into a storm main. Insulate entire length of storm main up to 33' (10 m) beyond the last runout;

.3 Entire length of horizontal storm piping above hard ceilings.

.2 Type 2 insulation may be used for all pipe sizes 10” (300mm) and greater.

Table 2 – Insulation Type & Thickness Schedule

Application	Operating Temperature (F)	Type	Less than 1"	1 TO 1-1/4"	1-1/2" TO 3"	4 TO 6"	8" and Larger
Equipment drain lines, Safety Relief, etc.	Up to 93 C (200° F)	Type 1	1.5" 40mm	1.5" 40mm	2" 50mm	2" 50mm	2" 50mm
Hot water Heating	Up to 93 C (200° F)	Type 1	1.5" 40mm	1.5" 40mm	2" 50mm	2" 50mm	2" 50mm
Domestic Cold Water	4.4 C to 10 C (40° F to 50° F)	Type 1	1" 25mm	1" 25mm	1" 25mm	1.5" 40m	1.5" 40mm
Domestic Hot water	Up to 60 C (Up to 140 F).	Type 1	1" 25mm	1" 25mm	1.5" 40mm	1.5" 40m	1.5" 40mm
Domestic Hot Water Recirc.	Up to 60 C (Up to 140 F).	Type 1	1" 25mm	1" 25mm	1.5" 40mm	1.5" 40m	1.5" 40mm
Storm Water	4.4 C to 10 C (40° F to 50° F)	Type 1 + Type 2	1" 25mm	1" 25mm	1" 25mm	1" 25mm	1" 25mm
Refrigerant Piping		Type 3	1/2" 12mm	1" 25mm	1" 25mm	1" 25mm	1.5" 40mm

3.5 FINISHES:

.1 Canvas:

.1 Apply in exposed areas on piping with operating temperatures 80 C (180 F) and above.

.2 Compacted firm, ULC listed, heavy plain weave, cotton fabric at 220g/m2 (6 oz. per sq. yd) treated with diluted fire retardant lagging adhesive.

.3 On concealed valves and fittings use ULC listed plain weave cotton fabric at 120 g/m2 (3 oz. per sq. yd)

.2 Aluminum or Stainless Steel

.1 Apply in areas exposed to the outdoors

.2 To CSA HA Series M1980:

.3 Crimped or embossed alloy jacketing 0.045mm (0.016") 26 gauge thick with longitudinal slip joints and 50mm (2") end laps with factory attached protective liner on interior surface. Aluminum alloy butt straps with mechanical fasteners;

.4 Jackets on fitting, 0.045mm (0.016") thick, die shaped components of alloy with factory attached protective liner on interior surface.

.3 PVC:

.1 Apply in exposed areas on piping with operating temperatures less than 80 C (180F).

.2 Piping: ULC listed PVC moulded type jacketing material, gloss white complying with 25 Flame Spread and 50 Smoke Developed ratings.

.3 Fittings: ULC listed PVC, gloss white, 1 piece, pre moulded fittings complying with 25 Flame Spread and 50 Smoke Developed ratings.

.4 PVC Application: strictly in accordance with the requirements of Authorities having jurisdiction.

.5 Ultraviolet resistant.

.6 Fastenings: To manufacturers standard(s).

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 Related Sections

.1 Section 22 05 15 – Plumbing Specialities and Accessories.

.2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

.3 Section 22 11 17 – Domestic Water Piping - Copper.

.4 Section 23 21 14 – Hydronic Systems Piping and Valves

.5 Section 23 23 00 – Refrigerant Piping

1.2 References

.1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 start up of hvac equipment & systems

.1 Prior to the start up of equipment the Division 22/23/25 Contractor shall arrange to have the Manufacturer of all major equipment including but not limited to boilers, cooling towers, chillers, air handling units, isolators, silencers, pumps, domestic hot water heaters and humidifiers to inspect the installation to ensure their equipment has been installed in accordance with their recommendations.

.2 The Supplier shall submit a written report of their findings.

.3 Upon confirmation that the equipment has been installed in accordance with the Manufacturers Recommendations the equipment may be started.

.4 All equipment shall be started by the Manufacturer’s representative.

1.4 Cleaning and Start-up of Mechanical Piping Systems

.1 In accordance with Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems.

1.5 Hydronic Systems - Performance Verification (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of two (2) working days to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Boiler and/or chiller operation.

.3 Pressure bypass open/closed.

.4 Control pressure failure.

.5 Maximum heating demand.

.6 Maximum cooling demand.

.7 Boiler and/or chiller failure.

.8 Cooling tower (and/or industrial fluid cooler) fan failure.

.9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.6 Hydronic System Capacity Test

.1 Timing: After:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures at all times to ensure that coils are not subjected to freezing conditions) or

.2 Reducing space temperature by turning off heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heat exchanger, heating coil and radiation control valves.

.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

.3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.7

1.8 Potable Water Systems

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in mechanical Division.

.2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

1.9 Wet and Dry Pipe Sprinkler System, Standpipe and Hose Systems

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in other mechanical Divisions.

.2 Verification of controls, detection devices, alarm devices is specified other mechanical and electrical Divisions.

.3 Demonstrate that fire hose will reach to most remote location regardless of partitions, obstructions, etc.

.4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.10 Sanitary and Storm Drainage Systems

.1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.5 Cleanouts: Refer to Section 22 05 15 - Plumbing Specialities and Accessories.

.6 Roof drains:

.1 Refer to Section 22 05 15 - Plumbing Specialities and Accessories.

.2 Remove caps as required.

1.11 Reports

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements: supplemented as specified herein.

1.12 Training

.1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements: supplemented as specified in relevant specification sections

PART 2 Products (Not Applicable)

PART 3 Execution (Not Applicable)

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 RELATED SECTIONS

.1 Section 01 74 00 – Cleaning and Waste Processing

.2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.3 Section 23 25 00 – HVAC Water Treatment Systems.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E202 – Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada / Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Instructions: submit manufacturer's installation instructions.

.1 Owner's Representative will make available one (1) copy of systems supplier installation instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading.

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 – Common Product Requirements.

.2 Waste Management and Disposal:

.1 Construction / Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction / Demolition Waste Management and Disposal.

PART 2 Products

2.1 CLEANING SOLUTIONS

.1 Low foaming detergent at all temperatures

.2 No pH neutralization required

.3 Designed for use on most metals including aluminium

.4 Bio-degradable

.5 Phosphate Free

.6 Nitrite Free

PART 3 Execution

3.1 CLEANING HYDRONIC SYSTEMS

.1 Timing

.1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.2 Cleaning procedure to be developed with the Water Treatment Provider.

.5 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Closed Loop Hydronic Systems:

.1 Provide a copy of recommended cleaning procedures and chemicals for approval by Consultant.

.2 Provide chemicals and labour for cleaning all water piping systems.

.3 Flush system thoroughly with water, back flush pump, strainers, blow down drain valves and risers to remove all loose debris. Remove accumulated sludge in boilers if necessary.

.4 Provisions shall be made for temporary connections between the supply and return mains and/or distribution branch piping in the system as required to permit circulation of the cleaner. A 1" (25 mm) pipe connection shall be provided on the suction side of the circulating pumps for introduction of the cleaning solution.

.5 The Contractor shall introduce a neutral pH cleaner and rust remover into each system at a dosage recommended by the water treatment supplier. The cleaner shall not attack carbon steel, copper, stainless steel, bronze,

brass, aluminum, plastics or natural and synthetic rubbers. Flash rusting shall not occur after cleaning.

.6 The cleaner shall be circulated at a temperature of 33.8F to 176F (1 C to 80 C) for a period of not less than 72 hours. PH adjustment shall be carried out by the water treatment supplier's representative.

.7 During the cleaning process, occasionally flush solution through drain valves to remove scale and deposits that have been liberated by the cleaning, back flush strainers, drain valves and risers at their lowest point once every 8 hours.

.8 Drain cleaning water completely.

.9 Each system shall be drained, refilled with fresh water, re-circulated for a period of 12 hours, drained a second time, and immediately refilled and treated with the recommended corrosion inhibitor.

.10 On existing systems the contractor shall allow for flushing of the system at least four (4) times as required.

.11 Bleed system at several points until water is clear and non-foaming. Clean pump strainers.

.12 Draw a water sample from the system and send it to out laboratory for analysis.

.13 If the laboratory report is satisfactory, the system must then be treated with the appropriate formula.

3.2 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing (TAB).

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.15 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open all balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.3 CLEANING

.1 Provide in accordance with Section 01 74 00 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.

.2 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 22 05 01.

.3 For the requirements for flushing and cleaning of new piping refer to Section 23 25 01 of the specification.

.4 For the requirements for hangers and supports refer to Section 23 05 29 of the specification.

.5 All valves must have a valid CRN Number. Statutory declaration must be provided on request.

1.2 RELATED SECTIONS.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 23- Health and Safety.

.3 Section 01 74 00 - Cleaning and Waste Processing.

.4 Section 01 78 10 - Closeout Submittals.

.5 Section 21 05 00 - Common Work Results -Mechanical.

.6 Section 23 05 17 - Pipe Welding.

.7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.8 Section 23 07 13 – Duct Insulation.

.9 Section 23 07 19 –Piping Insulation.

.10 Section 23 08 13 - Performance Verification of Mechanical Systems.

.11 Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.

.4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange and Lag Screws (Inch Series).

.6 ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.7 ASME B31.1 – latest edition, Power Piping.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536, Standard Specification for Ductile Iron Castings.

.4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 American Water Works Association (AWWA).

.1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CAN/CSA B51 – latest edition, Boiler, Pressure Vessel and Pressure Piping Code

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-58 – latest edition, Pipe Hangers and Supports – Materials, Design

.2 MSS-SP-67, Butterfly Valves.

.3 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.4 MSS-SP-71, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.5 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.6 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

.6 Ontario Regulations

.1 Ontario Regulation 220/01: Boilers and Pressure Vessels

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Closeout Submittals.

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals, and include the following:

.1 Special servicing requirements.

1.5 QUALITY ASSURANCE

.1 Health and Safety.

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00– Cleaning and Waste Processing.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

.2 In accordance with manufacturer's instructions.

.3 All piping shall be protected from any damage during shipping, handling and storage. All pipe ends shall be covered to prevent accumulation of dirt and debris inside the piping.

.4 Contractor shall be responsible for handling and delivery of all materials. Replace all damaged and/or defective materials at no cost to owner.

1.7 MAINTENANCE

.1 Extra Materials.

.1 Provide following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

PART 2 Products

2.1 PIPE

.1 NPS 2 and Smaller:

.1 Schedule 40, continuous weld or electric resistance welded black carbon steel conforming to ASTM A53, Grade B with threaded ends / plain ends.

.2 Type ”L” hard drawn copper tubing conforming to ASTM B88. Type ”L” soft annealed copper tubing may be used within convector enclosures.

.3 Type ”K” soft annealed copper tubing conforming to ASTM B88 with no joints permitted below the floor for below grade applications. Use approved tube bender for tube bending.

.2 NPS 2-1/2 and Larger:

.1 Schedule 40, continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 Grade B, with bevelled ends.

.2 For all welded connections provide the following:

.1 Prior to Starting work on Site each welder shall provide the following:

.1 Three qualification sample welds for inspection.

.2 These sample welds shall be submitted to the Consultant for review, stored, and identified for validation records.

.3 These welds shall be utilized to certify the welder and machine acceptability.

.2 Visual inspection shall be completed on all Hydronic Piping. Xray/Radiographic testing is only required if the visual inspection of a weld fails based on the requirements in Section 23 05 17.

.3 5% of Hydronic piping shall be visually inspected based on the requirements of Section 23 05 17. If failures occur within the first 5% of visual inspection an additional 10% of the piping shall be visually inspected.

2.2 UNIONS

.1 NPS and Smaller

.1 All brass construction with ground joint and either solder joint or screwed ends as required.

.2 Class 150 black malleable iron construction with brass to iron ground joint and screwed ends, conforming to ASTM A197 and ANSI/ASME B1.20.1.

.3 Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping or equipment.

2.3 FITTINGS

.1 NPS 2 and Smaller:

.1 Wrought copper solder joint pressure type, with IPS to copper adapters at screwed connections. Solder shall be tin antimony 95:5 to ASTM B32

.2 T Drill couplings are acceptable provided that the joints are made with silver brazing alloy conforming to AWS Classification BCuP 5. T drilling shall only be utilized for branch lines where the branch line is 1/2 the size or smaller than the main.

.3 Class 150 black malleable iron screwed fittings conforming to ASTM A197 and ANSI/ASME B16.3

.4 Class 2000 forged steel socket welding type, conforming to ASTM A105 Grade 2 and ANSI/ASME B16.11.

.2 NPS 2-1/2 and Larger:

.1 Schedule 40 seamless carbon steel butt welding fittings conforming to ASTM A234 WPB and ANSI/ASME B16.9.

.3 Provide Canadian Registration Numbers (CRN).

2.4 FLANGES

.1 Class 150 forged steel slip on or weldneck raised face type conforming to ASTM A181 Grade 1 and ANSI/ASME B16.5. Remove raised face where flanges connect to Class 125 cast iron valves.

.2 Hinged, 2 piece, shouldered or keyed cast malleable iron conforming to ASTM A47 Grade 32510 with elastomeric gasket suitable for service and lock bolt.

.3 Provide Canadian Registration Numbers (CRN).

2.5 GASKETS AND BOLTS

.1 Gaskets:

.1 1/16" (1.6 mm) Garlock 3200 with SBR binder or equivalent asbestos free material.

.2 Bolts:

.1 Semi finished hex head machine bolts and semi finished hex nuts, both of carbon steel conforming to ASTM A307 Class A.

2.6 HANGERS AND SUPPORTS

.1 In accordance with Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

2.7 PLUGS

.1 NPS 2 and Smaller:

.1 Class 3000 screwed, square head, machined from solid steel or forging to ASTM A105 Grade 2.

2.8 VALVES

.1 General

.1 Provide bronze valves with bodies made of bronze conforming to ASTM B62.

.2 Use gate and globe valves of a design which permits valve to be re packed under pressure when fully open.

.3 Provide valves with manufacturer's name or trade mark, figure number and pressure rating cast or stamped on valve body.

.4 Provide globe, angle and check valves with composition discs with manufacturer's recommended disc for type of service on which it is to be used, unless otherwise specified.

.5 Install balancing valves in piping for balancing purposes where shown on the drawings, details or schematics.

.6 All valves shall have appropriate CRN numbers.

.2 Globe Valves

.1 NPS 2 and Under - Screwed:

.1 To MSS SP 80, Class 150, 1000 kPa, bronze body, screwed over bonnet, renewable composition disc.

.2 Lockable handles.

.3 Standard of Acceptance: Jenkins: 106BJ, Crane, Kitz, Grinnell

.2 NPS 2 1/2 and Over - Flanged:

.1 To MSS SP 85, Class 125, 860 kPa, F.F. flange, cast iron body, bronze trim, OS&Y, bolted bonnet, bronze disc and seat ring.

.2 Standard of Acceptance: Jenkins 2342J, Crane, Kitz, Grinnell

.3 Gate Valves

.1 NPS 2 and Under - Screwed:

.1 Rising Stem: To MSS SP 80, Class 125, 860 kPa, bronze body, solid wedge disc.

.2 Standard of Acceptance: Jenkins 810J, Crane, Kitz, Grinnell.

.2 NPS 2 1/2 and Over - Flanged:

.1 Rising Stem: To MSS SP 70, Class 125, 860 kPa, FF flange, cast iron body, OS&Y bronze trim.

.2 Standard of Acceptance: Jenkins 454J, Crane, Kitz, Grinnell.

.4 Automatic Circuit Balancing Valves

.1 General

.1 Circuit balancing valves shall be of the automatic variety. Manual circuit balancing valves will not be accepted.

.2 Circuit Balancing Valves are required on the following systems:

.1 Heating Loop

.1 At each air handling unit, reheat coil, force flow unit, fan coil, radiant heating manifold, unit heater, force flow heaters, heat exchangers.

.2 At the main branches as shown on the drawings. Size for flow rates indicated on the schematic.

.3 Automatic balancing valves are not required at convectors.

.3 Automatic flow control valve cartridges shall automatically control flow rates with 5% accuracy over an operating pressure differential range of at least 14 times the minimum required for control.

.4 Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.

.5 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.

.6 All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.

.7 Standard control range shall be 14-220 kPa (2-32 psid) unless specifically indicated. Maximum design head loss of any valve not to exceed 21 kPa (3 psid) unless specifically indicated.

.8 Valve size to be determined by selection based on flow rate and design head loss. If necessary, valve body size shall be increased to meet the specification requirement for design head loss.

.9 Shop Drawing Submission

.1 The Balancing Valve Manufacturer shall submit a complete list of balancing valves, their location and their performance.

.2 The Balancing Valve Manufacturer shall mark up a set of full size plans showing the location of each balancing valve and assign an appropriate identification tag for the balancing valve.

.3 The Balancing Valve Manufacturer shall submit these drawings for the Consultant to review, incorporate any comments from the Consultant and then submit copies of this drawing to the Mechanical Contractor, Mechanical Consultant, Architect and Construction Manager.

.4 All balancing valves shall be shipped to site with this tag number firmly attached to the valve and the full size drawings shall be utilized to identify the location where they are to be installed.

.10 Body Styles

.1 Pipe size 50 mm (2”) and lower

.1 Sizes 13 mm to 50 mm (1/2" to 2”), shall have a ASTM brass alloy body, rated at no less than 2,760 kPa/121 °C (400 psi/250 F).

.2 These sizes shall be constructed in a one-piece body to include a handle ball valve, a flow control cartridge assembly, dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end which will accept various end pieces.

.3 The body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.

.4 The body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include two Teflon seals, one Viton o-

ring and one EPDM o-ring for protection against chemicals and variable operating temperature.

.5 The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

.2 Pipe size 63 mm (2-1/2”) and 76 mm (3”)

.1 Valves shall have an ASTM A536-80 Class 50-40-18 ductile iron body with ANSI 150# flanges. These sizes shall include a mounted butterfly isolation valve with NBR seat, ductile disc and stainless steel stem. Pressure/temperature test valves for verifying accuracy of flow performance shall also be included.

.2 The body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.

.3 The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

.3 Pipe sizes 100 mm (4”) and higher

.1 Class 150 Wafer valves shall consist of a gray iron (ASTM A126-61T, Class 30) body and stainless steel flow control cartridge assemblies; shall be rated at 1380 kPa/121 °C) (200 psi/250 F); shall be mechanically compatible with ANSI B16.5-1968 150# steel flanges; valve shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate; shall have single or multiple, parallel-installed stainless steel cartridge assemblies to provide rated flow rate; shall include all plated steel studs required for installation.

.2 Class 300 Wafer valve shall consist of a ductile iron (ASTM A536-65T, Class 60-45-18) body and stainless steel flow control cartridge assemblies; shall be rated at 3,450 kPa/204 C (500 psi/400 F) and shall be mechanically compatible with ANSI B16.5-1968 300 lb. steel flanges. Valve shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate; shall have single or multiple, parallel-installed stainless steel cartridge assemblies to provide rated flow rate; shall include all plated steel studs required for installation.

.11 Standard of Acceptance: Griswold Automatic Flow Control, Belimo, Hays, Oventrop Pressure Independent Control Valves, Siemens or approved alternate.

.5 Control Valve Bypass

.1 Provide control valve sizes and types as indicated in the following Table - Control Valves Sizes And Types - Bypass:

TABLE - CONTROL VALVES SIZES AND TYPES - BYPASS

Line Size	Globe Valve Size	Ball Valve Size
3/4" (20 mm)	Not Applicable	3/4" (20 mm)
1" (25 mm)	Not Applicable	3/4" (20 mm)
1-1/4" (32 mm)	1" (25 mm)	Not Applicable
1-1/2" (40 mm)	1" (25 mm)	Not Applicable
2" (50 mm)	1-1/2" (40 mm)	Not Applicable
2-1/2" (65 mm)	2" (50 mm)	Not Applicable
3" (75 mm)	2-1/2" (65 mm)	Not Applicable
4" (100 mm)	3" (75 mm)	Not Applicable

.6 Swing Check Valves

.1 NPS 2 and Under Screwed:

.1 To MSS SP 80, Class 125, 860 kPa, bronze body, horizontal swing check, bronze swing disc, screw in cap, regrindable seat.

.2 Standard of Acceptance: Crane: Fig. 37, Jenkins: Fig. 996AJ or 4092J, Toyo: 236, Kitz: Fig. 22, Grinnell: 3300.

.7 Double Door Wafer Check Valves

.1 NPS 2 1/2 and Over Grooved End Pipe:

.1 To MSS SP 71, Class 125, 860 kPa, ductile iron body, bronze or stainless steel discs, EPDM seat.

.2 Standard of Acceptance: Victaulic, Grinnell (Gruvlock), M.A.Stewart W30 Series

.8 Ball Valves

.1 NPS 2 and Under Branch Isolators Screwed:

.1 Rated for 600 WOG, brass body, chrome plated solid bronze ball, with Teflon seal.

.2 Ball valves shall have full port opening.

.3 All ball valves shall be provided with lockable handles where specified.

.4 Standard of Acceptance: Toyo: 5049, Kitz: 59, Grinnell: 3700, Apollo. Eastern Foundry and Fittings

.2 Soldered ends are only acceptable for valves that are NPS 3/4 installed in copper piping.

.9 Wall or Pedestal Mounted Radiant Panel Shut off and Balancing Valve

.1 NPS 3/4 and Under - Screwed:

.1 Straight or elbow union as required for installation.

.2 Chrome plated complete with union and tail piece exposed.

.3 Ball valve no handle, Allen key operation.

.4 Teflon seals good to 150 C (300F)

.5 Return Side Only: Integral Balancing Valve Spindle shall ensure simple and linear balancing, averaging 10% of max flow per turn.

.6 Tamper resistant Safety Cap.

.7 Standard of Acceptance: Frese, Ballofix, Broen. Eastern Foundry and Fittings

PART 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

.2 Inspect all materials upon delivery and prior to installation, any defective and/or unsatisfactory materials shall be removed from site.

.3 All joints and fittings shall be welded.

.4 All elbows shall be long radius, unless specified otherwise.

.5 Provide expansion compensators (including expansion loops) in the piping where required. Provide pipe alignment guides where required, including double guides at each side of expansion loops and/or compensators, with exact locations as per the expansion compensator supplier’s recommendations.

.6 Provide engineered anchors to secure pipework to the structure where required. Anchors shall be in accordance with reviewed shop drawings.

.7 Provide shut-off valves in piping connections to equipment, to isolate piping risers, and to isolate other sections of systems as required for proper operation and maintenance of the systems.

.8 Provide a check valve in the discharge piping of every pump and wherever else required for proper operation and maintenance of systems. Note that check valves for vertical inline circulating pumps are integral with the discharge accessory supplied with the pump.

.9 Provide a drain valve at the base of each piping riser, in drain connections to equipment, in low points of horizontal piping and wherever else required.

.10 Provide circuit balancing valves in piping where required but with exact locations in accordance with instructions of personnel doing system flow balancing work.

.11 Provide factory set pressure relief valves where required. Pipe the discharge of each relief valve to drain unless otherwise specified.

.12 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else required. Equip each air vent with a ball type shut-off valve.

.13 Provide strainers in piping where required. Clean strainer baskets after piping system flushing and cleaning is complete, and before water quantity balancing commences.

.14 Provide expansion tanks where required. Secure each vertical tank stand to a concrete housekeeping pad by means of machine bolts. Support horizontal tanks on steel saddles secured to the structure by means of hanger rods. Extend a drain line from each tank piping and terminate each drain line with a drain valve. Provide a water make-up connection line complete with relief valve pressure gauge for each tank. Terminate the make-up piping for connection to potable cold water piping.

.15 Provide hot water reheat coils for ductwork systems where required. Secure each coil in place from the structure by means of hanger rods, independent of connecting ductwork but ready for duct connections.

.16 Underground pre-insulated piping shall be installed as per manufacture instructions.

.17 Contractor shall obtain the services of the manufacture representative of Underground pre-insulated piping to review and certify installation as required.

.18 All piping fittings requiring access (valves, check valves, balancing valves, strainers, control valves, flow meters, etc) shall be installed with sufficient access for operation, servicing, cleaning, replacement and removal.

.19 All piping shall be independently supported.

3.2 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 16 - Cleaning and Start-Up of Mechanical Piping Systems

3.4 TESTING

.1 Test system in accordance with Section 21 05 00 - Common Work Results for Mechanical.

3.5 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 13 - Performance Verification of Mechanical Piping

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.

.2 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 22 05 01.

.3 For the requirements for flushing and cleaning of new piping refer to Section 23 08 13 of the specification.

.4 For the requirements for hangers and supports refer to Section 23 05 29 of the specification.

.5 All valves must have a valid CRN Number. Statutory declaration must be provided on request.

1.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 23- Health and Safety.

.3 Section 01 74 00- Cleaning and Waste Processing

.4 Section 01 78 10 - Closeout Submittals.

.5 Section 21 05 00 - Common Work Results For Mechanical.

.6 Section 23 05 17 - Pipe Welding.

.7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.8 Section 23 07 13 – Duct Insulation.

.9 Section 23 07 19 –Piping Insulation.

.10 Section 23 08 13 - Performance Verification of Mechanical Systems.

.11 Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.

.4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange and Lag Screws (Inch Series).

.6 ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.7 ASME B31.1 – latest edition, Power Piping.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536, Standard Specification for Ductile Iron Castings.

.4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).

.1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CAN/CSA B51 – latest edition, Boiler, Pressure Vessel and Pressure Piping Code

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-58 – latest edition, Pipe Hangers and Supports – Materials, Design

.2 MSS-SP-67, Butterfly Valves.

.3 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.4 MSS-SP-71, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.5 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.6 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

.6 Ontario Regulations

.1 Ontario Regulation 220/01: Boilers and Pressure Vessels

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Closeout Submittals.

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals, and include the following:

.1 Special servicing requirements.

1.5 QUALITY ASSURANCE

.1 Health and Safety.

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

.2 In accordance with manufacturer’s instructions.

.3 All piping shall be protected from any damage during shipping, handling and storage. All pipe ends shall be covered to prevent accumulation of dirt and debris inside the piping.

.4 Contractor shall be responsible for handling and delivery of all materials. Replace all damaged and/or defective materials at no cost to owner.

PART 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK FOR HYDRONIC SYSTEMS

.1 Horizontal and Vertical steel pressurized diaphragm type expansion tank.

.2 Size and Capacity: as per equipment schedule

.3 Diaphragm sealed in elastomer, suitable for 115 degrees C operating temperature.

.4 Working pressure: 860 kPa with ASME stamp and certification.

.5 Air precharged to initial fill pressure of system.

.6 Saddles for horizontal installation and Base mount for vertical installation.

.7 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

.8 Renewable diaphragm.

.9 Standard of Acceptance: Amtrol, Extrol, Taco, Armstrong, Bell and Gossett, Flofab

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 860 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS ½ connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

.4 Standard of Accpetance: Amtrol: No's. 700, 702, Maid O Mist: No. 7, Braukman: EA122, Taco: 417.

2.3 AIR VENT HIGH CAPACITY

.1 Float actuated high capacity air vent.

.2 Rated to shut off pressures of 150 psig (1040 Pa) at maximum temperature of 240 F. (115C).

.3 Vent shall be constructed of cast iron and fitted with components of stainless steel, brass and EPDM.

.4 Standard of Acceptance: ITT: Model 107A, Armstrong, Amtrol, Watts.

2.4 AIR SEPARATOR EXPANSION TANK FITTING

.1 Expansion tank air control fitting.

.2 Working Pressure: 860 kPa (125 psig).

.3 Adjustable vent tube and built in manual vent valve.

.4 Standard of Acceptance: Amtrol, Bell and Gossett, Taco

2.5 AIR/DIRTSEPARATOR (ADS) - IN LINE

.1 Provide in line air separator, refer to drawings for locations.

.2 Provide air separator with an NPT vent connection to facilitate installation of the piping to connect a compression tank or air separator to the air separator.

.3 An NPT tapping shall be provided on the bottom of the air separator to facilitate blowdown.

.4 Air eliminators / Dirt separators shall be fabricated steel, rated for 1,034kPa working pressure at 132°C, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles.

.5 Entering fluid velocities not to exceed 6 feet per second at specified GPM. Designated models specifically designed for high velocity systems may have an entering velocity of up to 10 feet per second. In no case shall entering velocity exceed 10 feet per second.

.6 Units shall include an internal bundle filling the entire vessel to suppress turbulence and provide high efficiency. The bundle shall consist of a copper core tube with continuous wound copper medium permanently affixed to the core. A separate copper medium is to be wound completely around and permanently affixed to each internal element.

.7 Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.

.8 Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

.9 Unit shall include a blow down valve at bottom for removal of collected dirt and sediment.

.10 Air eliminator function shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid during continuous circulation.

.11 Dirt and sediment separator function shall be capable of removing 80% of particles 30 micron and larger within 100 passes. A properly selected strainer

(see strainer specification) shall be installed upstream to collect large debris that may be left in the piping.

.12 Provide removal head to facilitate internal element inspection or cleaning if required. Bundle elements shall include tube sheets top and bottom and be manufactured as a bundle for ease or removal. Verify space required for bundle removal.

.13 Design all separators in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code.

.14 Pressure drop shall not exceed 1m w.c.

.15 Standard of Acceptance: Sprirotherm combination air eliminator/dirt separator or approved alternate.

2.6 EXPANSION TANK FITTING

.1 Expansion tank air control fitting.

.2 Working Pressure: 125 psig (860 kPa).

.3 Adjustable vent tube and built in manual vent valve.

.4 Standard of Acceptance: Amtrol, Bell and Gossett, Taco.

2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.8 WATER MAKE UP PRESSURE REDUCING VALVE

.1 Adjustable Low Pressure: 0.8 to 25 psig (55 to 172 kPa).

.2 Low inlet pressure check valve.

.3 Removable strainer.

.4 Standard of Acceptance: Bell & Gossett, Taco, Watts.

2.9 HYDRONIC SYSTEM PRESSURE SAFETY RELIEF VALVE

.1 Valve: to ASME Section IV.

.2 Body Construction: brass.

.3 Adjustable Pressure Setting: 8 to 25 psig (55 to 172 kPa).

.4 Maximum Operating Differential Pressure From Open To Close:

.5 3 psig (20 kPa).

.6 Standard of Acceptance: Bell & Gossett, Taco, Watts.

2.10 PIPE LINE STRAINER

.1 "Y" Type Strainer Class 125.

.2 NPS 1/2 2: bronze body, screwed connections complete with screwed cleanout.

.3 NPS 2 1/2 12: cast steel body, flanged connections or grooved end complete with bolted cleanout.

.4 Size: Line size.

.5 Blowdown Connection: NPS 1.

.6 Screen: stainless steel with perforated size of 1/32" (0.8 mm) for strainers 2 NPS and less, 1/16" (1.6 mm) for strainers 2 1/2 NPS and larger.

.7 Working Pressure: 125 psig (860 kPa).

.8 Standard of Acceptance: Sarco, Watts, A.S. Leitch.

2.11 FLOW MEASURING DEVICES

.1 In accordance with Section 23 05 19 – Meters and Gauges for HVAC Piping

2.12 PUMP INLET AND OUTLET

.1 Pump inlet shall be equipped with isolation, flexible connector, strainer and suction guide.

.2 Pump outlet shall be equipped with individual balancing, check discharge valve, flexible connector and isolation valves (triple duty valves will not be accepted).

.3 All pump inlet and outlet fittings shall be c/w preformed and removable insulation with jacketing.

2.13 PUMP SUCTION GUIDE

.1 On suction side of pump provide a suction guide as follows:

.1 Ductile iron body conforming to ASTM A-395.

.2 The coupling gasket shall be grade E EPDM rated for -30 F to 230 F (-34 C to 110 C) service.

.3 The diffuser shall be stainless steel type 304, frame and perforated sheet with 5/32" (4mm) diameter holes for pipe sizes 12" (300mm) and smaller and 3/16" (4.8mm) diameter holes for 14" (350mm) and larger.

.4 The removable start up filter shall be 20 mesh stainless steel type 304.

.5 Bolts and nuts shall be heat treated carbon steel, track head conforming to physical properties of ASTM A 183 minimum tensile strength of 110,000 psi.

.6 Connections shall be flanged on the discharge and either grooved or flanged as determined by the Division 15 Contractor.

.7 Provide strainer blow down connection and pressure gauge tappings.

.8 Provide adjustable support leg.

.2 Standard of Acceptance: Armstrong, Bell & Gossett, Victaulic, Taco.

2.14

PART 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

.6 Provide expansion compensators (including expansion loops) in the piping where required. Provide pipe alignment guides where required, including double guides at each side of expansion loops and/or compensators, with exact locations as per the expansion compensator supplier’s recommendations.

.7 Provide engineered anchors to secure pipework to the structure where required. Anchors shall be in accordance with reviewed shop drawings.

.8 Provide shut-off valves in piping connections to equipment, to isolate piping risers, and to isolate other sections of systems as required for proper operation and maintenance of the systems.

.9 Provide a check valve in the discharge piping of every pump and wherever else required for proper operation and maintenance of systems. Note that check valves for vertical inline circulating pumps are integral with the discharge accessory supplied with the pump.

.10 Provide a drain valve at the base of each piping riser, in drain connections to equipment, in low points of horizontal piping and wherever else required.

.11 Provide factory set pressure relief valves where required. Pipe the discharge of each relief valve to drain unless otherwise specified.

.12 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else required. Equip each air vent with a ball type shut-off valve.

.13 Provide strainers in piping where required. Clean strainer baskets after piping system flushing and cleaning is complete, and before water quantity balancing commences.

.14 Provide expansion tanks where required. Secure each vertical tank stand to a concrete housekeeping pad by means of machine bolts. Support horizontal tanks on steel saddles secured to the structure by means of hanger rods. Extend a drain line from each tank piping and terminate each drain line with a drain valve. Provide a water make-up connection line complete with relief valve and pressure gauge for each tank.

.15 Terminate the make-up piping for connection to potable cold water piping. Provide reduced pressure principle (RPZ) backflow prevented at connection to potable water supply. All piping downstream of the backflow shall be labeled as “Make Up Water Piping – Non Potable”.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each automatic control valve larger than NPS 1 except at radiation.

.4 An inline strainer shall be installed in condenser water systems in addition to the suction diffuser. Strainer in the suction diffuser shall be removed prior to project turnover.

.5 Install differential pressure (DP) meters across each strainer on main district heating and cooling distribution; DP meter shall indicate alarm once the strainer is clogged.

3.3 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

.3 On large capacity air vent, install ball valve upstream of air vent.

3.4 PRESSURE SAFETY RELIEF VALVES

.1 Install where indicated and to manufacturers instruction.

.2 Pipe outlet to nearest drain.

3.5 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

.3 Install all expansion tanks neoprene pads on housekeeping pads.

3.6 VERIFICATION

.1 Verification requirements in accordance with Division 01, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Local/regional materials.

.6 Low-emitting materials.

3.7 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.8 SUCTION DIFFUSERS

.1 Install on inlet to pumps and to manufacturers instructions.

.2 The Division 15 Contractor shall inspect the strainer prior to the start up of the pump and shall remove the fine mesh stainless steel strainer after a short running period.

3.9 VENTURI CHECK VALVES

.1 Install venturi check valves downstream of the pumps as shown on the drawing and in accordance with manufacturers' instructions. Provide a minimum of 600 mm straight run prior to the check valve.

3.10 FLOW METERS

.1 Install flow meter c/w pulse output (20 pulses per gallon) on each make-up water connection to cooling tower(s), hydronic heating and integrate into BAS. Coordinate installation with controls contractor.

3.11 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems

3.12 TESTING

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.13 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.14 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 - Cleaning and Waste Processing

.3 Section 01 35 23- Health and Safety.

.4 Section 01 78 10 - Closeout Submittals.

1.3 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

.1 Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 National Energy Code of Canada for Buildings (NECB).

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturer's Association (NEMA)

.1 NEMA MG 1, Motors and Generators.

.5 American National Standards Institute/Hydraulics Institute (ANSI/HI)

.1 ANSI/HI 1.3, Rotodynamic (Centrifugal) Pumps for Design and Application.

1.4 SUBMITTALS

1.5 SUBMITTAL

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.3 Submit manufacturer's installation instructions.

.4 Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.

.5 Under provisions of commissioning documentation, testing of pumps, as well as training of owner's operation and maintenance personnel may be required in cooperation with the commissioning consultant.

.6 Product Data including certified performance curves and rated capacities of selected model, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.

.7 Complete Package information Product Data including:

.1 System summary sheet (where applicable)

.2 Sequence of Operation

.3 Shop drawing indicating dimensions, required clearances and location and size of each field connection

.4 Power and control wiring diagram

.5 System profile analysis including pump curves, system curve, and variable speed pump curves (where applicable)

.6 Pump data sheets - Rated capacities of selected models and indication of pump's operating point on curves.

.7 Submittals on furnished specialties and accessories

.8 Submittals must be specific to this project. Generic submittals will not be accepted

.8 Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

.9 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

.10 Provide maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

1.6 QUALITY ASSURANCE

.1 All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

.2 Ensure pump operation, at specified system fluid temperatures without vapor binding and cavitation, is non-overloading in parallel or individual operation, and operates to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

.3 Ensure pump pressure ratings are at least equal to system's maximum operating pressure at point where installed but not less than specified.

.4 Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the engineer.

1.7 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste material for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers, steel, metal, plastic waste in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to the site in such a matter as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Materials damaged by the elements should be packaged in such a matter that they could withstand short-term exposure to the elements during transportation.

.2 Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.

.3 Use all means necessary to protect equipment before, during, and after installation.

1.10 WARRANTY

.1 A. Provide a minimum One (1) year warranty on materials and installation.

PART 2 Products

2.1 EQUIPMENT

.1 Do component selection and sizing to CAN/CSA-B214.

2.2 IN-LINE CIRCULATORS

.1 The pumps shall be close-coupled, inline for vertical or horizontal installation, in cast iron bronze fitted (or all bronze) construction specifically designed for quiet operation. Suitable standard operations at 250°F and 175 PSIG working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.

.2 As an option, an EPR/Graphite loaded Silicon-Carbide/Graphite loaded Silicon-Carbide.

.3 The pumps shall have a solid stainless-steel shaft that is integral to the motor.

.4 The motor bearings shall support the shaft via heavy-duty permanently lubricated ball bearings.

.5 Pump shall be equipped with an internally-flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Seal assembly shall be the unitized type with stainless steel drive tabs, EPR bellows and seat gasket, stainless steel spring, and be of a carbon silicon-carbide design with the carbon face rotating against a stationary silicon-carbide face.

.6 Pump shaft shall connect to a brass impeller. Impeller shall be hydraulically and dynamically balanced, threaded onto the motor shaft.

.7 Pump should be designed to allow for true back pull-out access to the pump's working components for ease of maintenance.

.8 Pump volute shall be of a cast iron design for heating systems or cast brass for domestic water systems. The connection style on the cast iron and bronze pumps shall be flanged. Volute shall include gauge ports at nozzles.

.9 Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors shall have permanently lubricated ball bearings sized to offset the additional bearing loads associated with the closed-coupled pump design. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications. Motor shall meet the requirements of Common Motor Requirements for HVAC Equipment and as per manufacturer's recommendations. Speed and power as indicated in the pump schedule.

.10 Pumps shall conform to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

.11 Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.

.12 Pump manufacturer shall be ISO-9001 certified.

.13 Each pump shall be factory tested and name-plated before shipment.

.14 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.15 Capacity: as indicated in the pump schedule.

.16 Standard of Acceptance: Bell and Gossett, Armstrong, Taco, Flo-Fab

2.3 VERTICAL IN-LINE CIRCULATORS

.1 The pumps shall be close-coupled or split coupled, inline for vertical or horizontal installation, in cast iron fitted construction specifically designed for quiet operation. Suitable standard operations at 225°F and 175 PSIG working pressure (or optional operations at up to 250°F and 250 PSIG working pressures). Working pressures shall not be de-rated at temperatures up to 250°F. The pump internals shall be capable of being serviced without disturbing piping connections.

.2 As an option an EPR/Carbon/Tungsten/Carbide/SS seal (250°F maximum operating temperature) seal may be used in lieu of the standard Buna/Carbon/Ceramic/SS seal (225° F maximum operating temperature).

.3 The pumps shall have a solid alloy steel shaft that is integral to the motor. A non-ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.

.4 The motor bearings shall support the shaft via heavy-duty grease lubricated ball bearings.

.5 Pump shall be equipped with an internally flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Seal assembly shall have a stainless-steel housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.

.6 Pump shaft shall connect to a stainless-steel impeller. Impeller shall be hydraulically and dynamically balanced to Hydraulic Institute Standards ANSI/HI 9.6.4.-2016. The allowable residual imbalance conforms to ANSI grade G6.3, keyed to the shaft and secured by a stainless-steel locking cap screw or nut.

.7 Pump should be designed to allow for true back pull-out access to the pump’s working components for ease of maintenance.

.8 Pump volute shall be of a Class 30 cast iron design for heating systems rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges (Optional 250 and 300 PSIG working pressures are available and are 250# flange drilled). Volute shall include gauge ports at nozzles, and vent and drain ports. The volute shall be designed with a base ring matching an ANSI 125# flange that can be used for pump support.

.9 Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors shall have heavy-duty grease lubricated ball bearings to offset the

additional bearing loads associated with the closed-coupled pump design. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications. Motor shall meet the requirements of Common Motor Requirements for HVAC Equipment and as per manufacturer's recommendations. Speed and power as indicated in the pump schedule.

.10 Pumps shall conform to ANSI/HI 9.6.3.1-2012 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

.11 Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.

.12 Pump manufacturer shall be ISO-9001 certified.

.13 Each pump shall be factory tested and name-plated before shipment.

.14 As an option, the pump may include an internal stainless-steel casing wear rings.

.15 Where noted on schedule pumping equipment may require one or all of the following optional tests: Certified Lab tests (unwitnessed), Hydraulic Institute Level B tests, or Witnessed Tests.

.16 Capacity: as indicated in pump schedule.

.17 Pumps 7.5hp and larger shall be split coupled construction.

.18 Standard of Acceptance: Bell and Gossett, Armstrong, Taco, Flo-Fab

PART 3 Execution

3.1 INSTALLATION

.1 Install equipment in accordance with manufacturer's instructions.

.2 Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow.

.3 Furnish and install triple duty valves on the discharge side of all pumps and furnish and install a line size shut-off valve on the suction side of all pumps. Anywhere that 5 straight pipe diameters of pipe cannot be provided on the inlet side of a pump a suction diffuser shall be used to provide appropriate flow distribution into the eye of the pump's impeller.

.4 Provide temperature and pressure gauges where and as detailed or directed.

.5 On systems where pump seals require flushing water or cooling water for a heat exchanger kit, provide cooling water supply piping and connections as well as the return piping, if required. Piping should be of adequate size to pass required flow rate.

.6 Proper access space around a device should be left for servicing the component. No less than the minimum recommended by the manufacturer.

.7 Provide an adequate number of isolation valves for service and maintenance of the system and its components.

.8 Circulating pump shall have sufficient capacity to circulate the scheduled GPM against the scheduled external head (feet) with the horsepower and speed as scheduled and/or as denoted on the drawings. Motors shall be of electrical characteristics as scheduled, denoted and/or as indicated on the electrical plans and specifications. Pump characteristics shall be such that the head of the pump under varying conditions shall not exceed the rated horsepower of the drive motor.

.9 On systems where the final balancing procedure requires the triple duty valve to be throttled more than 25% to attain design flow (on a constant speed pumping system), and no future capacity has been built into the pump, the pump impeller must be trimmed to represent actual system head resistance. The pump provider and engineer of record, based on the balancing contractor's reports, shall determine the final impeller trim diameter.

.10 All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping. All piping shall be fitted to the pumps even though piping adjustments may be required after the pipe is installed.

.11 On components that require draining, contractor must provide piping to and discharging into appropriate drains.

.12 Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer's instruction and applicable state, federal, and local codes.

.13 Control wiring for remote mounted switches and sensor / transmitters shall be the responsibility of the control's contractor. All wiring shall be performed per manufacturer's instructions and applicable state, federal, and local codes.

.14 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.15 Pipe drain tapping to floor drain.

.16 Install volute venting pet cock in accessible location.

.17 Check rotation prior to start-up.

.18 Install pressure gauge ball valves.

3.2 START-UP

.1 General

.1 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system, over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.10 Eliminate cavitation, flashing and air entrainment.

.11 Adjust pump shaft seals.

.12 Measure pressure drop across strainer when clean and with flow rates as finally set.

.13 Replace seals if pump used to degrease system or if pump used for temporary heat.

.14 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION (PV) AND COMMISSIONING

.1 General

.1 In accordance with manufacturer's recommendations.

.2 Assumptions: These PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.3 Net Positive Suction Head (NPSH):

.1 Application: Measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in the ANSI/HI 1.6.

.3 Where procedures do not exist, discontinue PV, report to Owner's Representative and await instructions.

.4 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Pump performance curves (family of curves).

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for copper tubing and fittings for refrigerant.

1.2 RELATED SECTIONS:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 23 - Health and Safety.

.3 Section 01 74 00 - Cleaning and Waste Processing

.4 Section 01 78 10 - Closeout Submittals.

.5 Section 23 07 19 – Piping Insulation.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.

.3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B 280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA)

.1 CSA B52, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.1 EPS1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Province of Newfoundland and Labrador Boiler, Pressure Vessel and Compressed Gas Regulations

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

.5 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

.3 Trades people to be journeyperson and graduate from a recognized college refrigeration trade program.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers, steel, metal, plastic waste in accordance with Waste Management Plan (WMP).

.5 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative

PART 2 Products

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B280, type ACR B (nitrogenized).

.2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121°C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 45% Ag - 80% Cu - 5% P and non-corrosive flux for copper to steel or brass; Silfoss-15 for copper to copper.

.3 Flanged:

.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300, tongue and groove type.

.2 Gaskets: suitable for service.

.3 Bolts, nuts and washers: to ASTM A307, heavy series.

.4 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

.1 7/8 ODS and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moistureproof seal for below freezing applications, brazed connections.

.2 Over 7/8 ODS: Class 375, 3 MPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and forged brass bonnet, moisture-proof seal for below freezing applications, brazed connections, non-rotating, self aligning swivel disc, Teflon seat, -40^{0}C - 163^{0}C.

.3 Ball valves 7 3/8 ODS to 3 1/8 ODS: maximum WP 4MPa, -40^{0}C to 149^{0}C, live loaded stem seal, double “O” ring hermetically sealed body, blowout proof stem, seal cap “O” ring sealed, valve position indicators, forged brass body bonnet, brass cap, triple sealed plated steel item, Teflon ball seals and gasket, extended copper connections, helium leak test to maximum 0.28 g/yr.

.4 Check valves 7/8 ODS to 3 1/8 ODS cast bronze body, brass bonnet, Teflon seat, internal parts removable minimum opening pressure 3.5 kPa, maximum WP 3.5 kPa - 29^{0}C to 149^{0}C, UL and CSA approved.

.5 Check valves 3/8 ODS to 7/8 ODS: brass construction, Teflon seal, removable piston, maximum WP 3.5 kPa, -40^{0}C to 149^{0}C, suitable for high side, low side and hot gas. UL and CSA approved, maximum opening pressure 3.5 kPa.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5.

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

.1 General:

.1 Soft annealed copper tubing: bend without crimping or constriction, hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 1800 mm high and at each 6000 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified above.

.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

.3 Test Procedure: Build pressure up to 35 kPa using nitrogen leave for 8 hours.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines for largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa absolute and hold for 4 h.

.2 Break vacuum with refrigerant to 14 KPa.

.3 Final to 5 Pa absolute and hold for at least 12 h.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Submit test results to Owner’s Representative.

.7 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system in fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:

.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Record and report measurements to Owner's Representative.

.9 Manufacturer's Field Services:

.1 Have manufacturer of products, supplied under this Section, review work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review work, at stages listed:

.1 After delivery and storage of products, and when preparatory work, or other work, on which the work of this Section depends, is complete but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of the work, after cleaning is carried out.

.4 Obtain reports, within three (3) working days of review, and submit, immediately, to Owner's Representative.

3.7 DEMONSTRATION

.1 Instructions:

.1 Post instructions in frame with glass cover in accordance with Section 01 78 10 – Closeout Submittals and CSA B52.

.1 Perform cleaning operations as specified in Section 01 74 00 – Cleaning and in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 summary

.1 Section includes:

.1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment.

.2 Products specified in this section include the following:

.1 Chemical Corrosion Inhibitors for Water Treatment

.2 Chemicals for Flushing and Cleaning

.3 Chemical By-Pass Pot Feeder

.4 Side Stream Filter Housing

.5 Corrosion Coupon Rack

.6 Packaged Automatic Glycol Feed System

.7 Propylene Glycol

1.2 Related Sections

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing.

.3 Section 01 78 10 – Closeout Submittals

.4 Section 23 0816 – Cleaning and Startup of HVAC Piping Systems.

1.3 References

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, Section VII.

.2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Materials Safety Data Sheets (MSDS)

1.4 submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

.2 Include rated capacities; water-pressure drops; shipping, installed, and operating weights; and complete data on furnished products listed below

.1 Pot Feeders

.2 Coupon Racks

.3 Glycol Feed System

.4 Flow Indicators

.5 Valves

.6 Product specifications and MSDS's for each chemical used

.7 Cleaning Procedures

.8 Passivation Procedures

.9 Chemical Treatment Procedures

.10 Shop Drawings

.2 Shop Drawings:

.1 Submit Shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings to include detailed equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and the location and size of each field connection as necessary to assist the mechanical contractor with proper system installations.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout submittals:

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

.2 Include the following:

.1 Log sheets as recommended by Owner's Representative.

1.5 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety

.2 Trades people to have journeyperson qualifications and training provided by the manufacturer.

1.6 delivery, storage, and handling

.1 Packing, shipping, handling, and unloading:

.1 Deliver, store, and handle in accordance with manufacturer's written instructions and Section 01 61 00 –Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing..

PART 2 Products

2.1 general

.1 Provide a Chemical Services Provider to perform the services described below.

.1 Provide water treatment products and services including:

.1 Chemicals for cleaning, passivation, and treatment of each system.

.2 On- going treatment, chemicals, testing, certification, and reports to demonstrate effective water treatment is maintained at all times.

.3 Start-up and operation of chemical treatment equipment.

.2 Provide a complete chemical water treatment program during construction for all new and reused piping networks. This program shall begin from the point each system is filled during construction and extend until Substantial Completion or final Owner acceptance of each system, whichever occurs later. The program shall include water analysis, chemicals, testing, equipment, consulting and service for the following systems:

.1 Hot Water Heating System

.2 Chilled Water System

.3 Glycol Systems

.4 All other closed loop systems

.3 Attend project meetings as required to plan, schedule and coordinate above activities with other project contractors and the Owner.

.4 Provide recommended testing procedures and chemical treatment schedule for Owner's personnel. This information shall be submitted to the owner in a Program Administration Manual.

.5 Equipment, chemicals, service provided by one supplier.

2.2 bypass Pot Feeders and side stream filters

.1 Bypass filter and pot feeders to be supplied and installed in the following systems:

.1 Closed Loop Hot water heating systems

.2 Closed Loop Chilled water systems

.2 Bypass feeder; capacity 2 US gallons (7.5L) minimum, at operating gauge pressure, 1400 kPa. Bypass feeder to be complete with inlet, outlet, drain valves.

.3 Filter units sized at 2.5 - 5% of total recirculation rate. Provide sufficient quantity of 20-micron bleached cotton filter elements for a minimum of 5 filter changes. One (1) Sight Flow Indicator, installed after filter and sized appropriately on the by-pass line to determine filter change.

2.3 Chemical Feed Piping

.1 Schedule 80 Pipe threaded connections.

2.4 closed loop hot water systems chemical treatment.

.1 Prior to chemical treatment all closed looped heating piping systems to be mechanically cleaned in accordance with the requirements of Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

.2 Provide bypass pot feeder and filter as described above.

.3 Chemical treatment to consist of a nitrite based closed system treatment which shall protect the piping system by forming a thin film on the internal piping surfaces.

.4 Solution to be added through bypass chemical pot feeder specified previously.

.5 Provide one (1) test kit to verify water treatment performance.

.6 Recommended start-up dosage to be in accordance with feedrate as determined by water treatment system supplier. For purpose of tendering consider:

.1 800-1200 ppm for Nitrite

.7 Solution to arrive on site in sealed drums or pails in liquid form. Contractor responsible to store the chemical in a cool, dry, well ventilated area.

.8 Product data:

.1 Liquid.

.2 Clear pale yellow colour.

.3 Zero degree Celsius freeze point.

.4 pH of 11-12

.5 Specific gravity of 1.132.

.9 Provide one (1) year supply of chemical to protect systems from corrosion.

.10 Provide material safety data sheets for chemicals and reagents.

.11 Provide one four port corrosion coupon rack 25mm (1") diameter in line with the bypass feeder for each system to allow for monitoring of on line corrosion rates.

.12 Provide one makeup water meter for each system with local totalizer display and adjustable digital pulse output for connectivity to a water treatment controller or the BAS.

2.5 glycol

2.6 CONDUCTIVITY CONTROLLER

.1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0 5000 micromhs.

.2 Insensitive to phase angle shifts, capable of operating on 95 130 Volts without affecting accuracy, power, bleedoff status lights.

2.7 CONDUCTIVITY PROBES

.1 Dual carbon elements in PVC holder, quick disconnect, self locking connection.

2.8 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 District heating system: pot feeder, 25 L, operating pressure 1400 kPa.

.2 District cooling system: pot feeder, 25 L, operating pressure 1400kPa.

.3 CHP (high temp heating): pot feeder, 25 L, operating pressure 1400kPa.

.4 Glycol system: pot feeder, 7.5 L, operating pressure 1400 kPa.

.5 Side stream micron filter housing for each pot feeder:

.6 Capacity 2.5% t0 5% of total pump recirculating rate at operating pressure.

.7 Six (6) sets of 20 micron filter cartridges for each type and size of micron filter.

2.9 CHEMICALS

.1 Provide 1 years supply from date of commissioning.

.2 Obtain chemicals from one manufacturer with existing valid contract with Sheridan College (WMC / GE Water).

2.10 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

PART 3 ExecutioN

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

.3 Coordinate with the installing contractor to ensure equipment is installed in conformance with manufacturer’s recommendations and those found in the specification.

.4 If deficiencies are noted by the field service representative, the contractor shall make the necessary corrections and the manufacturer’s field service personnel will visit the installation site and oversee any corrections and or modifications required. A written report shall be filed with the Engineer at each visit.

3.3 GENERAL

.1 Supply and feed into each system sufficient chemical to charge the system to proper concentrations of chemical, and supply and feed into each system all chemicals required to maintain proper levels in the system.

.2 Arrange for the chemical supplier's personnel to check chemical levels in the systems, to certify in writing that the feed equipment is properly installed and that water in the system is properly treated with chemical.

.3 Provide 20mm copper pipe connection to nearest floor drain for all equipment drain connections (pot feeder, filter, etc).

3.4 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

.2 All chemical treatment piping shall be insulated c/w PVC jacketing and identification.

.3 Chemical treatment piping and tubing shall be installed in organized manner.

3.5 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Engineer.

.2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.

.3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Flush and clean the new heating steam, glycol, chilled water and condenser water piping systems prior to plant start-up and performance and acceptance tests, but after leakage testing is complete.

.6 Provide temporary piping connections for introduction of cleaning solution and by-passes at capped connections and wherever else required. Ensure thorough cleaning solution circulation throughout systems.

.7 Thoroughly flush the piping with raw water to remove loose mill scale and debris. Remove and clean all strainers and flush low point areas before chemical cleaner is added to the system. Add new system chemical cleaner with 5-10 gallons per 1000 gallons system water for the removal of oil, mill scale and iron oxides. Recirculate the solution for a period of seventy-two (72) hours at a temperature of from 68°F to 140°F (20°C to 60°C).

.8 The exact period of time shall be as required to produce a clean piping system. When the chemical solution circulating period is complete, drain the solution from the piping, refill with clean water and circulate the water for a minimum of four (4) hours to flush out remaining chemical solution, then drain the water from the piping and again clean all system strainers.

.9 Acceptability of water condition to be determined to be determined through testing and visual examination of representative water samples, by the water treatment supplier. Arrange for the water treatment supplier's personnel to check the systems after flushing and cleaning is complete and to certify in writing that flushing and cleaning procedures have been properly performed. Copies of test

reports to be submitted by the water treatment supplier to the Mechanical Contractor for verification to the Consultant.

.10 Disposal of cleaning solutions approved by authority having jurisdiction.

.11 Fill the systems with the required treatment chemicals.

3.6 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of one year after system start up. Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start up assistance.

.3 Operating staff training.

.4 Visit plant every days during period of operation and as required until system stabilizes, and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for one year operation.

.6 Provide necessary laboratory and technical assistance.

.7 Provide clear, concise, written instructions and advice to operating staff.

3.7 FIELD QUALITY CONTROL

.1 Start up:

.1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning:

.1 Commissioning Agency: water treatment supplier.

.3 Timing:

.1 After start up deficiencies rectified.

.2 After start up and before TAB of connected systems.

.4 Pre commissioning Inspections: verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of raw water analysis.

.4 Required quality of treated water.

.5 Commissioning procedures applicable to Water Treatment Systems:

.1 Establish, adjust as necessary and record automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Engineer in writing on matters regarding installed water treatment systems.

.6 Commissioning procedures Water Softeners:

.1 Demonstrate compliance with specifications by chemical analyses of raw water and treated water.

.2 Determine, demonstrate actual softening capacity between regenerations.

.3 Establish regeneration intervals and procedures.

.4 Train O&M personnel in regeneration procedures.

.7 Commissioning procedures Water side of closed circuit coolers, Cooling Tower Systems:

.1 Verify operation of bleed off system.

.2 Establish bleed off flow rate.

.3 Establish rate of chemical feed continual and periodic.

.4 Test system water for chlorides, TDS, suspended solids, algae, slime, inhibitor level, pH, alkalinity, hardness, other impurities and microbiological organisms.

.5 Compare with readings of total dissolved and suspended solids metre.

.6 Read make up water metre, compare with chiller load summation (ton hours).

.7 Test make up water for chlorides, hardness.

.8 Compare test results with readings from TDS metre.

.9 Record quantity of make up water, compare with summation of chiller load (in ton hours).

.10 Record types, quantities of chemicals applied.

.8 Commissioning procedures Closed Circuit Hydronic Systems:

.1 Analyze water in system.

.2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.9 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.2 Train O&M personnel in softener regeneration procedures.

.10 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.11 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Engineer.

.12 Demonstrations: as per Engineers request

.13 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Engineer.

.14 Verification requirements in accordance with Division 01, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Low-emitting materials.

3.8 CLEANING

.1 Proceed in accordance with Division 01.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.9 EXTENDED SERVICES

.1 Provide costing to carry out a further four (4) years of water treatment in addition to the one (1) year already specified.

.2 Identify individual costing for each year.

END OF SECTION

PART 1 General

1.1 summary

.1 Section includes:

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 Related Sections

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 23 – Health and Safety

.3 Section 01 74 00 – Cleaning and Waste Processing

.4 Section 07 84 00 – Fire Stopping and Smoke Seals

.5 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

1.3 References

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE 90.1,

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A 480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.

.3 ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA).

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 National Fire Protection Association (NFPA).

.1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .2 SMACNA HVAC Air Duct Leakage Test Manual.
- .3 IAQ Guideline for Occupied Buildings Under Construction, 1st Edition.

.7 Transport Canada (TC).
- .1 Transportation of Dangerous Goods Act (TDGA).

1.4 submittals

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS - Material Safety Data for the following:
- .1 Sealants.
- .2 Tape.
- .3 Proprietary Joints.

1.5 quality assurance

.1 Certification of Ratings:
- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.
- .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

.3 Installers to be certified to journeyperson level in sheet metal work.

1.6 delivery, storage and handling

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 Products

2.1 general

.1 Construct and install all sheetmetal ductwork unless otherwise noted in accordance with ANSI/SMACNA 006-2006 HVAC Ductwork Construction Standards – Metal and Flexible.

.2 Perform duct leakage testing in accordance with ANSI/SMACNA 016-2012 HVAC Air Duct Leakage Test Manual and ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.

2.2 Seal Classification

.1 Classification as follows:

Static Pressure Range	SMACNA Seal Class	Leakage Class CFM per 100ft2 at 250Pa (1" w.g.)	
		Rectangular Ductwork	Round Ductwork
1000 Pa to -1000 Pa (4" w.g. to -4" w.g.)	A	6	3
750 Pa to – 750 Pa (3" w.g. to -3" w.g.)	B	12	6
500 Pa to -500 Pa (2" w.g. to -2" w.g.)	C	24	12
250 Pa to -250 Pa (1" w.g. to -1" w.g.)	C	24	12
125 Pa to -125 Pa (.5" w.g. to -.5" w.g.)	C	24	12

.2 Seal classification Requirements:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed.

.3 Ductwork shall be constructed in accordance with the SMACNA Seal Classification within in each part of the systems based on the following table:

Static Pressure Range	SMACNA Seal Class	Ductwork Application
1000 Pa to -1000 Pa (4" w.g. to -4" w.g.)	A	Exterior Ductwork
750 Pa to – 750 Pa (3" w.g. to -3" w.g.)	B	Intake and Exhaust Air Plenums
750 Pa to – 750 Pa (3" w.g. to -3" w.g.)	B	Supply Air Ductwork Upstream of Terminal HEPA Diffusers
250 Pa to -250 Pa (1" w.g. to -1" w.g.)	C	Return Air Ductwork
125 Pa to -125 Pa (.5" w.g. to -.5" w.g.)	C	Other Ductwork

2.3 Sealant

.1 Utilize water based sealant

.2 Sealant shall meet
- .1 UL 181B-M Listed
- .2 UL 723 Classified
- .3 ULS 102
- .4 ASTM D522
- .5 ASTM D2202

.3 Sealant shall conform to requirements of NFPA 90A & 90B

.4 VOC limits must qualify for LEED® Credit EQ 4.1

.5 Sealant shall be Permanently flexible

.6 Sealant shall be Non-flammable

.7 Sealant shall have Exceptional workability

.8 Sealant shall not drip or sag

.9 Sealant shall have Low shrinkage

.10 Sealant shall have Excellent adhesion to metal

.11 Sealant shall be used Indoor or outdoor use

.12 Sealant shall be Mildew resistant

.13 Sealant shall be Paintable – latex or epoxy paints

.14 Sealant shall be rated For applications up to 15" w.g.

.15 Application temperature 1.7 C to 43.3 C (35 F to 110 F).

.16 Service temperature -17.8 C to 105.6 C (0 F to 222 F).

.17 Standard of Acceptance: Ductmate or approved equivalent

2.4 Duct Leakage

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual Appendix A

.2 All ductwork shall be tested regardless of seal classification.

.3 As required by ASHRAE 90.1: representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested.

2.5 Fittings

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

- .1 Rectangular: Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius or five-piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

- .1 Only provide mitred elbows where indicated on drawings or when agreed to by the consultant.
- .2 Double thickness turning vanes.

.4 Branches:

- .1 Rectangular main and branch: with radius on branch 1.5 times width of duct or 45^0 entry on branch.
- .2 Round main and branch: enter main duct at 45^0 with conical connection.
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with balancing damper.

.5 Transitions:

- .1 Diverging: 20^0 maximum included angle.
- .2 Converging: 30^0 maximum included angle.

.6 Offsets:

- .1 Full short radiused elbows as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 Firestopping

.1 Refer to Section 22 33 16 – Fire and Smoke Dampers.

2.7 Galvanized Steel

.1 Lock forming quality: to ASTM A653, G90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class C seal.

2.8 Stainless Steel

.1 To ASTM A480/A480M, Type 304 or 316 based on the following table.

.2 Finish: No 4. finish on exposed side of duct in finished area's, No. 3 finish or lower where concealed.

.3 Thickness, fabrication and reinforcement: to SMACNA.

.4 Joints: to SMACNA and be continuous inert gas welded. Spiral lockseam will not be accepted.

.5 All stainless steel shall be passivated.

Ductwork Application	Type of Stainless Steel
Kitchen Exhaust ductwork exposed within the Kitchen	304 with No. 4 finish
Dishwasher exhaust where exposed within the Kitchen	304 with No. 4 finish
Supply air downstream of HEPA filters	316
Exterior Exhaust stacks	304

2.9 Hangers and Supports

.1 Refer to Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

.2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.

.3 Hanger configuration: to SMACNA.

.4 Hangers: galvanized steel angle with black steel rods to ASHRAE or SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50 x 50 x 6	10

.5 Upper hanger attachments:

.1 Refer to Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

2.10 high transmission loss (htl) ductwork

.1 High Transmission Loss ductwork shall be fabricated from a minimum of 10 gauge.

2.11 INTERNALLY LINED ROUND DUCTWORK

.1 Round ductwork indicated to be internally lined utilize spiral round insulated duct with double wall including external pressure tight metal shell, 25mm (1") fibreglass insulation and an internal perforated liner.

.2 The external shell and couplings shall comply with the specification for round ductwork.

PART 3 Execution

3.1 General

.1 Do work in accordance with NFPA 90A, NFPA 90B, and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation. Do not place fire stopping material in expansion space between damper sleeve and fire partition.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 Hangers

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA or as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 Watertight Duct

.1 Provide watertight duct for:
- .1 Dishwasher exhaust.
- .2 Fresh air intake.
- .3 Ductwork downstream of duct mounted humidifiers
- .4 Minimum 3000 mm from duct mounted humidifier in all directions.
- .5 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards fume hoods served. Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm deep drain sump and NPS 1.5 drain connected, with deep seal trap and valve and discharging to open funnel drain or service sink or as approved by Owner’s Representative.

3.4 stacks

.1 All exposed stacks shall be 304 stainless steel.

.2 Stacks shall be provided with guy wires.

.3 Support stacks as required.

3.5 Sealing and Taping

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations. Sealant and tape to be applied to full perimeter of duct.

3.6 Leakage Tests/COMMISSIOONING

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections and submit test results for all sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Install no additional ductwork until trial test has been passed.

.5 Test section minimum of 30 m long with not less then three branch takeoffs and two 90º elbows.

.6 Complete test before insulation or concealment.

3.7 DUCTWORK CLEANING

.1 Prior to shipping ductwork from the factory all ductwork that is indicated to be cleaned above shall be vacuumed and cleaned utilizing approved duct cleanser. Shrink wrap the ends with plastic to ensure cleanliness.

.2 Install ductwork with ends sealed. The ends shall only be opened just prior to making connection between duct sections.

.3 Seal the ends of ductwork that are not currently being worked on with plastic.

.4 Vertical risers shall be sealed with sheet metal. Plastic is not acceptable.

.5 Where the plastic protecting the ductwork is damaged the ductwork shall be recleaned on site utilizing approved ductwork cleanser.

.6 Where ductwork is contaminated on site the ductwork shall be recleaned. Sections that require dismantling to clean shall be dismantled recleaned and then reinstalled.

.7 When/if the ductwork is NOT cleaned properly, the Consultant shall have the authority to have all ductwork and/or sections recleaned if not cleaned properly. Periodic checks will be performed.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 Related Sections

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 23 – Health and Safety.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 74 00 – Cleaning and Waste Processing.

.5 Section 01 78 10 – Closeout Submittals.

1.3 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.2 Submit WHMIS MSDS in accordance with Section 02 62 00.01 – Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan (WMP).

.5 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative.

PART 2 Products

2.1 General

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Connections

.1 Frame: galvanized sheet metal frame 0.66 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40^0C to plus 90^0C, density of 1.3 kg/m^2.

2.3 Access Doors in Ducts

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Hold open devices.

.2 300 x 300 mm glass viewing panels.

.3 Up to 300 x 300 mm: two sash locks complete with safety chain.

.4 301 to 450 mm: four sash locks complete with safety chain.

.5 451 to 1000 mm: piano hinge and minimum two sash locks.

.6 Doors over 1000 mm: piano hinge and two handles operable from both sides.

.1 Hold open devices.

.2 300 X 300 mm glass viewing panels.

2.4 Turning Vanes

.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 Instrument Test PORTS

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 Spin-In Collars

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

PART 3 Execution

3.1 manufacturer’s instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Flexible connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access doors and viewing panels:

.1 Size:

.1 600 x 600 mm for person size entry.

.2 450 x 450 mm for servicing entry.

.3 300 x 300 mm for viewing.

.4 As indicated.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.3 Instrument test ports.

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations.

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Owner's Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.3 Controls

.1 Adjacent to all control sensors provided by the Controls Contractor to allow for verification of the readings provided by these sensors. This includes but is not limited to temperature, releative humidity, pressure sensors and flow stations.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations as specified in Section 01 74 00 – Cleaning and Waste Processing and in accordance with Manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 Related Sections:

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 23 – Health and Safety.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 7400 – Cleaning and Waste Processing.

.5 Section 01 78 10 – Closeout Submittals.

1.3 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate the following:

.1 Specifications.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 –Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

PART 2 Products

2.1 General

.1 Manufacture to SMACNA standards.

2.2 splitter dampers

.1 Not accepted.

2.3 Single Blade Dampers

.1 Fabricate from same material as duct, 0.8 mm up to 450 mm wide, 1.6 mm maximum up to 1200 mm wide, V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon or bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 Multi-Bladed Dampers

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: pin in bronze bushings or self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage: 2 % at 500 Pa.

2.5 DIVERTING DAMPERS

.1 Adjustable, curved vanes, mounted in supporting frame.

.2 All aluminum construction.

2.6 IRIS DAMPERS

.1 Iris dampers shall be manufactured of hot dipped galvanized 22 gauge steel.

.2 Duct connections shall be gasketed and beaded to provide for a sealed duct connection.

.3 Airflow measurement taps shall be provided with airflow adjustment charts located on the damper for convenient airflow measurement and control. Damper shall be capable of controlling airflow to +/- 7% of design airflow with a minimum of one duct diameter straight duct leading into the unit.

.4 Damper position shall be set with the factory supplied spanner wrench, with no zero calibration required. Dampers requiring zero calibration are not acceptable. Casing leakage to the environment shall not exceed 6 cfm.

PART 3 Execution

3.1 manufacturer’s instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.4 Runouts to registers and diffusers: located as close as possible to main ducts.

.5 All dampers to be vibration free.

.6 Ensure damper operators are observable and accessible.

3.3 cleaning

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 summary

.1 Section Includes:

.1 Fire and smoke dampers, and fire stop flaps.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 23 – Health and Safety.

.3 Section 01 74 00 – Cleaning and Waste Processing

.4 Section 23 31 13 – Metal Ducts – Low Pressure to 1000 Pa.

1.3 References

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112, Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505, Fusible Links for Fire Protection Service.

.4 UL 555, Standard for Safety Fire Dampers.

.5 UL 555C, Standard for Safety Ceiling Dampers.

1.4 submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 Fire dampers.

.2 Smoke dampers.

.3 Fire stop flaps.

.4 Operators.

.5 Fusible links.

.6 Design details of break-away joints.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals

1.5 quality assurance

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

.2 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.6 maintenance

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 10 – Closeout Submittals.

.2 Provide the following:

.1 6 fusible links of each type.

1.7 delivery, storage, and handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processsing.

PART 2 Products

2.1 Fire Dampers

.1 Fire dampers: arrangement Type B or C, blades out of air stream listed and bear label of ULC, shall conform to the requirements of UL555 for fire dampers, authorities having jurisdiction and ANSI/NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112. Minimum rating 1 ½ hours, dynamically rated.

.2 Fire damper and frame shall match the material construction of the ductwork its being installed in. Factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; roll door type; or guillotine type; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 Retaining angle iron frame, 40 x 40 x 3 mm, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed to prevent disruption of ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC and in manufacturer's instructions for fire dampers shall be followed.

.11 Standard of Acceptance: EH Price, Nailor Industries, and Ruskin.

2.2 Smoke Dampers

.1 To be ULC listed and approved shall conform to the requirements of UL 555S Standard For Smoke Dampers and shall meet the requirements of NFPA 92A and Authorities having jurisdiction.

.2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

.3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.

.4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.

.5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74° C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

.6 Standard of Acceptance: EH Price, Nailor Industries, and Ruskin.

2.3 Combination Fire and Smoke Dampers

.1 Damper: similar in all respects to smoke dampers specified above.

.2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

.3 Standard of Acceptance: EH Price, Nailor Industries, and Ruskin

2.4 Fire Stop Flaps

.1 To be ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps to be held open with fusible link conforming to ULC-S505 and close at 74° C.

.4 Standard of Acceptance: EH Price, Nailor Industries, and Ruskin

PART 3 Execution

3.1 manufacturer's instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 – Air Duct Accessories.

.5 Coordinate with installer of firestopping to Section 07 84 00 – Fire Stopping and Smoke Seals.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

.8 The Mechanical Contractor shall review the Architectural Drawings. Any discrepancies between fire damper locations and the fire rated walls shall be brought to the attention of the Consultant.

3.3 cleaning

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 Summary

.1 Section Includes:

.1 Fans, motors, accessories, and hardware for commercial use.

1.2 Related Sections

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 35 23 – Health and Safety.

.3 Section 01 74 00 – Cleaning and Waste Processing

.4 Section 01 78 10 – Closeout Submittals

.5 Section 21 05 00 – Common Work Results for Mechanical

.6 Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

.7 Section 23 33 00 – Air Duct Accessories.

1.3 References

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 99, Standards Handbook.

.2 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.

.3 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.4 AMCA Standard 330, Method of Testing In Duct Sound Power Measurement Procedure for Fans.

.2 ARI Standards

.1 ARI Standard 575, Method of Measuring Machinery Sound Levels within Equipment Rooms.

.2 ARI Standard 350, Sound Rating of Non-Ducted Indoor Air Conditioning Equipment.

.3 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 AHSRAE 51, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1 Motors and Generators

.2 NEMA ICS 7.1 Safety Standard for Construction and Guide for Selection, Installation and Operation of Adjustable Drive Systems.

.7 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual, MPI #18, Primer, Zinc Rich, Organic.

1.4 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.3 Provide:

.1 Fan performance curves showing point of operation, BHP kW and efficiency.

.2 Sound rating data at point of operation.

.3 Dimensional data.

.4 Installation procedures.

.4 Indicate:

.1 Motors, sheaves, bearings, shaft details

.2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.6 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23- Health and Safety.

1.7 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.

.1 Spare parts to include:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Belts

.3 Addresses of suppliers.

.4 List of specialized tools necessary for adjusting, repairing or replacing.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

PART 2 Products

2.1 Fans General

.1 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

.5 Motors:

.1 Open drip proof outside of air stream, TEFC when in air stream, explosion proof as indicated in accordance with NEMA MG1.

.2 In accordance with Section 23 05 13 – Common Motor Requirements for HVAC Equipment supplemented as specified herein.

.3 For use with variable speed controllers where specified.

.4 Sizes as specified.

.5 Two speed with two windings and speeds of approximately 1200 or 900 r/min low and 1800 r/min high as indicated.

.6 Two speeds with split winding, constant horsepower or constant or variable torque as specified and speeds as indicated.

.6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards, fan inlet and/or outlet safety screens as indicated and as specified in Section 23 05 13 – Common Motor Requirements for HVAC Equipment, inlet or outlet dampers and vanes and as indicated.

.7 Factory primed before assembly in colour standard to manufacturer.

.8 Scroll casing drains: as indicated.

.9 Finish on fume hood exhaust fans: heresite coated

.10 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.11 Flexible connections: to Section 23 33 00 – Air Duct Accessories.

2.2 Centrifugal Fans

.1 Fan wheels:

.1 Welded steel or aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.

.3 Air foil or backward inclined blades, as indicated.

.2 Bearings: air handling quality, heavy duty, split pillow-block, flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life to ABMA L10 of 100,000 hours. Shaft seals on laboratory fume hood and biological safety cabinet exhaust fans:

.1 Single disc or stuffing box seals.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, cast iron, or steel, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide bolted latched airtight access doors with handles.

.4 Spark resistant construction Type B minimum where indicated.

.4 Variable volume control devices:

.1 Mounted by fan manufacturer.

.2 Variable Speed Drives: to NEMA ICS 7.1.

.5 Weatherproof Construction

.1 All fans mounted on the roof shall be provided with a weatherproof enclosure.

.6 Standard of Acceptance: Loren Cook, Greenheck, Chicago Blower, Barry Blower, New York Blower, Twin City.

PART 3 Execution

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Fan Installation

.1 Install fans as indicated, complete with resilient mountings, flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 Cleaning

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 Related Sections

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 45 00 – Quality Control.

.3 Section 01 74 00 - Cleaning and Waste Processing.

.4 Section 01 78 10 – Closeout Submittals.

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 AHSRAE 130, Methods of Testing for Rating Ducted Air Terminal Units.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 International Organization of Standardization (ISO)

.1 ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.5 Underwriter's Laboratories (UL)

.1 UL 181, Factory-Made Air Ducts and Air Connectors.

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer’s printed product literature, specifications and datasheet in accordance with Section 01 33 00 –Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

.2 Test data: to ANSI/AMCA 210.

.1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

.2 Sound power level with minimum inlet pressure of 0.25, 0.5, 1, and 1.5 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.

.3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

.2 Shop Drawings:

.1 Submit shop drawing in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

.5 Dimensions.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver store and handle in accordance with Section 01 61 00 –Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

1.7 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 10 – Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment. Include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

PART 2 Products

2.1 general

.1 The terminal units shall be factory-assembled, AHRI 880 rated and bearing the AHRI seal for an air volume control terminal with damper assembly and flow sensor.

.2 Performance Requirements:

.1 The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume.

.2 Use attenuation values found in AHRI 885 Appendix E.

2.2 Manufactured Units

.1 Terminal units of the same type to be product of one manufacturer.

2.3 Variable Volume Boxes

.1 Pressure independent factory reset to air flow between minimum and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated in schedule.

.3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.

.4 Sound ratings of assembly not to exceed 35 NC at 750 Pa. Use sound attenuator if necessary to achieve rating.

.5 Furnish and install single duct terminal units in the sizes and configurations as indicated on the plans.

.6 Unit Casing:

.1 The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.

.1 The casing shall be assembled with longitudinal lock seam construction.

.2 Casing leakage shall be tested in accordance with ASHRAE 130.

.3 Casing leakage for the basic assembly shall not exceed 1.0 percent of the maximum rated airflow at 1.0 inches of water gauge.

.4 Casing leakage for the basic assembly shall not exceed 2.0 percent of the maximum rated airflow at 3.0 inches of water gauge.

.7 Unit Discharge:

.1 Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

.8 Internal Liners:

.1 Fiberglass Liner - FG.

.1 Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.

.2 The insulation shall be secured with adhesive.

.3 Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.

.4 Insulation thickness shall be:

.1 1 inch thick, R-value of 4.1.

.9 Primary Air Damper Assembly:

.1 The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.

.2 The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.

.3 The damper shaft shall be mounted on the right of the damper when looking in the direction of airflow.

.4 The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.

.5 Air leakage past the closed damper shall not exceed 2 percent of the unit maximum rated airflow at 3.0 inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.

.6 The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

.10 Airflow Sensor:

.1 The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and mounted to the inlet valve.

.2 Plastic parts shall be fire-resistant, complying with UL 94.

.3 The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.

.4 Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.

.5 The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.

.6 After balancing, the airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range

.11 Inlet Valve:

.1 The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.

.2 The inlet valve shall include a 1/8 inch raised single bead weld for added strength.

.3 The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.

.4 The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

.12 Units shall be supplied with 4 inch x 6-3/4 inch bottom access door, secured to the casing with screws.

.13 Hot Water Heating Coil (Where applicable):

.1 The hot water coil casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal discharge with slip-and drive attachment for downstream ductwork.

.1 An optional gasketed access door shall be provided, located on bottom of unit.

.2 Coil handing shall be specified by the contractor upon ordering of the units.

.3 The water coil shall be supplied with an access door located:

.1 Upstream of the water coil in the terminal casing.

.4 The water coil access door shall be secured to the casing with

.1 Screws.

.2 The water coil fins shall be 0.0045 inch aluminum fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.

.1 Fins shall be formed in a high heat transfer sine wave configuration.

.2 Standard coil shall be a 10 fins-per-inch fin construction.

.3 High capacity coil shall be a12 fins-per-inch fin construction.

.3 All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a

maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.

.4 The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.

.1 An optional oversized casing shall be upsized to increase heat transfer with low supply water temperatures while reducing air side pressure drop.

.14 Electric Heating Coil (Where applicable):

.1 The electric heating coil shall be ETL listed to UL 1995 and CSA 22.2, and provided by the terminal unit manufacturer.

.2 The electric coil casing shall be constructed from a minimum 20 gauge, 0.038 inch galvanized steel.

.3 The heating elements shall be open wire nickel chrome construction, supported by ceramic insulators.

.4 The integral control panel shall be a NEMA 250, Type 1 enclosure with hinged access door for access to all controls and safety devices.

.5 The electric coils shall be provided with a primary automatic reset thermal cutout, a manual reset thermal cutout, and a differential pressure airflow switch for proof of airflow.

.6 The electric coils shall be provided with a silicon controlled rectifier (SCR) controller.

.15 Sound Attenuator:

.1 The manufacturer shall supply sound attenuators to meet scheduled acoustical performance requirements. The attenuators shall be supplied in the following configuration (select one):

.1 Three foot integral discharge attenuator

.2 Five foot integral discharge attenuator

.16 Control Transformers:

.1 The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

.17 Electrical Requirements:

.1 Single duct terminal units shall be provided with single-point power connection.

.2 The terminal unit equipment wiring shall comply with the requirements of NFPA 70.

.18 All digital controls including motor, transducer, controller, etc. to be supplied by the Control Contractor for factory installation by box manufacturer. The cost of the Installation of the controls shall be carried by the box manufacturer.

.19 Standard of Acceptance: EH Price, Titus, Nailor, Metalaire

PART 3 Execution

3.1 MANUFACTURER'S instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Support independently of ductwork.

.2 Install with at least 1000 mm of rigid inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.3 Locate so that controls, dampers and access panels are easily accessible.

.4 Install the terminal units in accordance with the manufacturer's instructions.

.5 Install the inlets of the air terminal units with the air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.

.6 See drawings for the size(s) and duct location(s) of the air terminal units.

.7 Provide ceiling access doors or locate units above easily removable ceiling components.

.8 Support the terminal units individually from the structure.

.9 Embed anchors in concrete in accordance with ASTM E488/E488M.

.10 Do not support the terminal units from the ductwork.

.11 Connect the terminals to the ductwork in accordance with Section 23 31 13.

.12 Install heating coils in accordance with Section 23 82 16.

.13 Verify that electric power is available and of the correct characteristics.

.14 Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 summary

.1 Section includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

1.2 Related Sections

.1 Division 1.

1.3 REFERENCES

.1 American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE).

.1 ASHRAE 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.

1.4 system description

.1 Performance requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 1. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 1.

.2 Indicate following:

.1 Capacity

.2 Throw and terminal velocity

.3 Noise criteria

.4 Pressure drop

.5 Neck velocity

.2 Quality assurance submittals: submit following in accordance with Division 1.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 1.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Division 1.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 1.

1.8 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Division 1.

.2 Include:

.1 Keys for volume control adjustment

.2 Keys for air flow pattern adjustment.

PART 2 Products

2.1 General

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators as indicated.

.4 Colour: standard or as directed by Owner's Representative.

2.2 Manufactured Units

.1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

PART 3 Execution

3.1 Manufacturer's instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Install in accordance with manufacturers instructions.

.2 Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.

.3 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere.

3.3 Cleaning

.1 Proceed in accordance with Division 1.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Heating boiler units:

.1 Fire tube.

.2 Cast iron.

.3 Coil tube hot water.

.4 Steam boilers.

.5 Oil burners.

.6 Installation.

.7 Commissioning.

1.2 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing.

.3 Section 01 78 10 - Closeout Submittals.

.4 Section 23 05 19 – Meters and Pressure Gauges For HVAC Piping

1.3 References

.1 American Boiler Manufacturer's Association (ABMA)

.2 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

.3 Canadian Standards Association (CSA)

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B139, Installation Code for Oil Burning Equipment.

.3 CSA B140.7.2 Oil-Fired Steam and Hot Water Boilers for Commercial and Industrial Use.

.4 National Electrical Manufacturers Association (NEMA)

.5 Health Canada/Workplace Hazardous Materials Information Systems (WHMIS)

.1 Material Safety Data Sheets (MSDS)

.6 Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittals Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate the following:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Foundations with loadings, anchor bolt arrangements.

.4 Piping hook ups.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 All miscellaneous equipment.

.8 Flame safety control systems.

.9 Breeching and stack configuration.

.10 Stack emission continuous monitoring system to measure CO, O, NOx, SO, stack temperature and smoke density of flue gases.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100%, and 110% of design capacity.

.2 Radiant heat loss at 100% design capacity.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with Canadian Environmental Protection Act (CEPA), Canadian Environmental Assessment Act (CEAA), Transportation of Dangerous Goods Act (TDGA), and applicable Provincial regulations.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 – Common Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/demolition waste management and disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.7 MAINTENANCE

.1 Extra materials:

.1 Special tools for burners, manholes, handholes and operation and maintenance.

.2 Spare parts for 1 year of operation.

.3 Spare gaskets – 1 set.

.4 Spare gauge glass inserts – 1 of each size and type.

.5 Probes and sealants for electronic indications – 1 set.

.6 Spare burner tips – 1 set.

.7 Spare burner gun – 1.

.8 Safety valve test gauge – 1.

PART 2 Products

2.1 General

.1 Packaged boiler:

.1 Complete with burner and necessary accessories and controls.

.2 Laboratory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA B140.7.2.

.3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.

.4 Designed and constructed to ANSI/ASME Boiler and Pressure Vessel Code.

.5 CRN (Canadian Registration Number), to CSA B51 and authority having jurisdiction.

.6 Boiler/burner package to bear ULC label.

.2 Performance:

.1 In accordance with American Boiler Manufacturers Association (ABMA) testing procedures.

.2 Steam: design steam pressure: 860 kPa capacity as indicated. Operating hot water: capacity as indicated.

.3 Firing rate: #2 oil. As indicated.

.4 Boiler efficiency: 80 % minimum at 30% to 100% firing rates.

.5 Flue gas temperature leaving boiler:

.1 Not to exceed 260°C.

.2 Above dewpoint conditions at minimum firing rate.

.3 Electrical:

.1 Power: 600 V, 3-phase, 60Hz.

.2 Controls: 120 V, 1 phase, 60Hz.

.3 Electrical components: CSA approved.

.4 Controls: factory wired. NEMA 1steel cabinet

.5 Thermal insulation:

.1 50 mm thick mineral fibre. Seal insulation at handholes, manholes, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.

.6 Jackets: heavy gauge metal, finished with heat resisting paint.

.7 Mounting:

.1 Structural steel base, lifting lugs.

.8 Anchor bolts and templates:

.1 Supply for installation by other Divisions. Anchor bolts to be sized to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.9 Start-up, instruction, on-site performance tests: three (3) working days per boiler.

.10 Trial usage:

.1 Owner's Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.

.2 Supply labour, materials and instruments required for tests.

.11 Temporary use by contractor:

.1 Contractor may use boilers providing warranty is not affected and only after written approval from Owner's Representative.

.2 Monitor and record performance continuously. Keep log of maintenance activities carried out.

.3 Refurbish to as-new condition before final inspection and acceptance.

.12 Approved Boiler Manufacturers;

.1 Viessmann, Lochinvar, De Deitrich, Enerpro, Fulton, Precision Boilers

.13 Non-Approved Manufacturers

.1 Johnson Patterson

2.2 Auxiliaries

.1 Provide for each boiler and to meet ANSI/ASME requirements.

.2 Hot water boilers:

.1 Relief valves: ANSI/ASME rated, set at 200 kPa, to release entire boiler capacity.

.2 Pressure gauge: to Section 23 05 19.13 – Thermometers and Pressure Gauges – Piping Systems, two times normal operating range.

.3 Thermometer: to Section 23 05 19.13 – Thermometers and Pressure Gauges – Piping Systems range two times normal operating range.

.4 Low water cut-off: with visual and audible alarms.

.5 Auxiliary low water cut-off: with separate cold water connection to boiler.

.6 Isolating gate valves: on supply and return connections.

.7 Drain valve: NPS 2.

.8 Stack thermometer: Range 65 to 400°C.

.9 Outdoor controller: to reset operating temperature controller.

.10 One 1 set of cleaning tools.

.3 Steam boilers:

.1 Safety valves: ANSI/ASME rated, set at 100 or 860 kPa , to release entire boiler capacity, complete with drip pan elbow and vent pipe.

.2 Pressure gauge: to Section 23 05 19.13 – Thermometers and Pressure Gauges – Piping Systems range 0 to 200 kPa, or 0 to 1800 kPa complete with siphon and ball valve.

.3 Water column assembly: with tri-cocks, gauge glass, protective rods, blowdown valves operated from firing floor.

.4 High water level: audible alarm.

.5 Low water level: fuel cut-off with visual and audible alarms and feedwater pump control switch.

.6 Feedwater regulator on 3-valve bypass with drain valve, stop valve and check valve.

.7 Continuous blow-down stop valve.

.8 Soot blower element, supply valve and drain valve.

.9 Auxiliary low water cut-off with separate cold water connection to boiler.

.10 Steam stop-check valve.

.11 Quick-opening blowdown valve and shut-off valve.

.12 Stack thermometer: range 65 to 400°C.

.13 Drain valve: NPS 2.

.14 One 1 set cleaning tools.

.4 Pot type chemical feeder.

2.3 Oil Burners

.1 General:

.1 Pressure-mechanical atomizing forced draft with:

.1 Built-in blower to supply combustion air, complete with motor, silencer and damper.

.2 Two stage oil pump driven by blower motor and complete with integral relief valve.

.3 Oil filter.

.4 Pressure gauge.

.5 High voltage ignition transformer.

.6 Flame observation port.

.7 Easy access to nozzles and electrodes.

.8 Oil and air metering controls for maximum burner efficiency throughout operating range.

.2 Electric oil heater: to heat fuel oil from pre-heat temperature to combustion temperature, even with voltage reduced by 20%, complete with 63 mm diameter thermometer on inlet and outlet.

.2 Turndown ratio: at least 3:1.

.3 Controls:

.1 Electronic combustion control relay with scanner for combustion control and flame supervision.

.2 Control to shut off fuel within 5 seconds upon flame failure or upon signal of safety interlock and to ensure, when restarted, in sequence, ignition and resumption of supervision of burner operation.

.3 Burner operation to include:

.1 Pre-purge.

.2 Pilot ignition and supervision.

.3 Burner operation.

.4 Post-purge upon burner shut-down.

.4 Immersion controllers:

.1 Operating: to start and stop burner and operating between adjustable setpoints.

.2 High-low: to shift burner operation to high or low fire.

.3 Modulating: to modulate burner output.

.4 High limit: manual reset, As indicated.

.5 Controller range: As indicated.

.5 Visual and audible alarms: to indicate burner shutdown due to flame failure, low water level, high pressure, low air pressure, low fuel pressure, low fuel temperature.

.6 Selector switch: to permit manual and automatic firing at any rate between low and high fire.

.7 Pilot lights: to indicate:

.1 Normal burner operation

.2 All stages of burner operation.

.8 Burner to start up in low fire position.

2.4 Emission Control

.1 Rate of discharge of air contaminants from boiler not to exceed:

.1 For nitrogen oxides expressed as nitrogen dioxide:

.1 43 ng/J of heat input when fired with oil specified as type 1 or 2, according to CGSB classification.

.2 22 ng/J of heat input when fired with gaseous fuel.

.2 For sulphur dioxide:

.1 25 ng/J of heat input when fired with oil specified as type 1 or 2, according to CGSB classification.

.3 For carbon monoxide, 125 ng/J of heat input.

PART 3 Execution

3.1 Installation

.1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount unit level.

.5 Pipe hot water relief valves full size to nearest drain.

.6 Pipe steam relief valve through roof with drip pan elbow piped to nearest drain.

.7 Pipe blowdown/drain to blowdown tank/floor drain.

.8 Oil fired installations - in accordance with CSA-B139.

.9 All boilers to be approved by the local authorities having jurisdiction. Obtain all required inspections and approvals prior to start-up and commissioning. Provide copies of affidavits, approval letters, etc., to the Owner's Representative for record purposes.

3.2 Mountings and Accessories

.1 Safety valves and relief valves:

.1 Run separate discharge from each valve.

.2 Terminate discharge pipe as indicated.

.3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

.2 Blowdown valves:

.1 Run discharge to terminate as indicated.

3.3 Factory Testing

.1 .1 The steam generator to be fire tested at the factory for at least two (2) eight-hour days. At this time combustion and controls to be adjusted over the entire output range.

.2 .2 After testing and prior to shipment, the equipment to be thoroughly cleaned, flushed, dried and painted.

3.4 FIELD QUALITY CONTROL

.1 Commissioning

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

.2 Provide Owner's Representative at least two (2) working days notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

.3 Final commissioning to occur between November and March when ambient temperature is 10° C or lower.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing.

.3 Section 01 78 10 – Closeout Submittals.

.4 Section 23 33 00 – Air Duct Accessories.

1.2 REFERENCES

.1 American Bearing Manufacturer's Association (ABMA)

.1 ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.

.2 ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.

.2 Air Movement and Control Association (AMCA)

.1 AMCA 210, Laboratory Method of Testing Fans for Aerodynamic Performance Rating (ASHRAE).

.2 AMCA 300 Reverberant Room Method for Sound Testing of Fans.

.3 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)

.1 ANSI/AHRI 430, Central Station Air Handling Units.

.2 ANSI/AHRI 1060, Performance Rating of Air-to-Air Heat Exchangers Energy Recovery Ventilation Equipment.

.4 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 68, Laboratory Method of Testing to Determine the Sound Power in a Duct.

.2 ASHRAE 84, Method of Testing Air-to-Air Exchangers.

.5 American Society for Testing and Materials (ASTM)

.1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.6 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

.7 Canadian Standards Association (CSA)

.1 CSA B52 Mechanical Refrigeration Code.

.8 National Electrical Manufacturer's Association (NEMA)

.1 NEMA MG1 Motors and Generators

.2 NEMA ICS 7-1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

.9 Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.

.10 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following: fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil, include performance data.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

.2 Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB, EWB, OAT.

1.5 Waste management and disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 00 - Cleaning and Waste Processing, and with the Waste Reduction Workplan.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Owner’s Representative.

.4 Divert unused paint material from landfill to official hazardous material collections site approved by Owner’s Representative.

.5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 10 – Closeout Submittals.

.2 Provide one spare set of filters.

.3 Provide list of individual manufacturer’s recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.4 Spare filters: in addition to filters installed for start-up and commissioning. Immediately prior to acceptance by Owner's Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.7 TRAINING

.1 Provide training in accordance with Section 01 79 00Demonstration and Training.

PART 2 Products

2.1 GENERAL

.1 Factory assembled, or field erected total energy recovery wheel arranged as indicated.

.2 —Performance:

.1 Capacity: as indicated.

.2 Efficiency: as indicated.

2.2 ENTHALPY MEDIA TYPE AIR TO AIR HEAT EXCHANGERS

.1 The rotor media shall be made of aluminum, coated to prohibit corrosion.

.2 All media surfaces shall be coated with a non-migrating solid absorbent layer prior to being formed into the honeycomb media structure to ensure that all surfaces are coated and that adequate latent capacity is provided.

.3 The media shall have a flame spread of less than 25 and a smoke development of less than 50 when rated in accordance with ASTM E84.

.4 In addition to the desiccant coating that is applied to the surfaces of the aluminum substrate, the two faces of the total energy recovery wheel shall be covered and sealed with a two-part polymer heavy duty coating specifically chosen for chemical resistance.

.5 Desiccant shall be inorganic and specifically developed for the selective adsorption of water vapour. Desiccant shall utilize a molecular sieve certified by the manufacturer to have an internal pore diameter distribution which limits adsorption to materials not larger than 2.8 angstroms.

.6 Media shall be cleanable with low-pressure steam (less than 35 kPa), hot water or light detergent, without degrading the latent recovery. Dry particles up to 800 microns shall pass freely through media.

2.3 AIR TO AIR FIXED PLATE EXCHANGER

.1 Casing: 0.8 mm thick galvanized steel, 0.8 mm thick stainless steel of anodized aluminum.

.2 Heat transfer surfaces: corrugated aluminum, edge sealed and bonded to casing.

.3 Cross contamination: not permitted.

.4 Condensate drain: NPS 2.

.5 Removable access panels.

.6 Performance characteristics: as indicated.

2.4 PURGE SECTOR

.1 Provide a factory set, field adjustable purge sector designed to limit cross contamination to less than 0.04 percent of that of the exhaust air stream concentration when operated under appropriate conditions.

2.5 ROTOR

.1 Seals:

.1 Supply rotor with labyrinth seals only, which at no time shall make contact with any rotating surface of the exchanger rotor face. These multi-pass seals shall utilize four labyrinth stages for optimum performance.

.2 Rotor Support System:

.1 Provide rotor media in segmented fashion to allow for field erection or replacement of one section at a time without requiring side access. Rigidly hold media in place by a structural spoke system made of extruded aluminum.

.3 Rotor Housing:

.1 The rotor housing to be a structural framework, which limits the deflection of the rotor due to air pressure loss to less than 0.8 mm. Construct housing of galvanized steel to prevent corrosion. Support rotor is supported by two pillow block bearings which can be maintained or replaced without the removal of the rotor from its casing or the media from it spoke system.

2.6 TEMPERATURE CONTROL PANEL

.1 Provide variable speed control of unit using an A/C inverter.

.2 Inverter to include all digital programming with a manual speed adjustment on the front of the inverter.

.3 Drive system to allow for a turndown ratio of 80:1 (20 rpm to ¼ rpm).

.4 The control system shall include four linearized thermistor sensors as follows:

.1 Supply air temperature sensor.

.2 Differential summer/winter changeover sensors mounted in the outdoor and return air streams.

.3 Frost prevention sensor located in the exhaust air stream.

.5 Provide certified BACnet interface to allow monitoring of all wheel control parameters by the building DDC system specified in Division 25.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Locate so that controls, dampers and access panels are easily accessible.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 summary

.1 Section includes:

.1 Direct Expansion (DX) Variable Refrigerant Flow HVAC System designed for air cooling and heating applications, using refrigerant R410a.

1.2 Related Sections

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 00 – Cleaning and Waste Processing.

.3 Section 01 78 10 – Closeout Submittals.

1.3 References

.1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)]

.1 Material Safety Data Sheets (MSDS)

.2 Air-Conditioning, Heating and Refrigeration Institute (AHRI)

.1 AHRI Standard 340/360

.2 AHRI Standard 350

.3 AHRI Standard 410

.4 AHRI Standard 540

.5 AHRI Standard 700

.6 AHRI (ANSI) 210/240

.7 AHRI Standard

.3 American Society of Refrigeration, Heating & Air Conditioning Engineers (ASHRAE)

.1 ASHRAE (ANSI) Standard 15 and 34

.2 ASHRAE Standard 55

.3 ASHRAE Standard 62.1

.4 ASHRAE Standard 90.1

.4 ASTM

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

.3 ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

.4 A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by Hot Dip Process.

.5 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate:

.1 Equipment, capacity, piping, and connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

.3 Special enclosures.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 Quality assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 Delivery, storage, and handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Processing.

PART 2 Products

2.1 General

.1 Submit manufacturer’s catalog data for the air-cooled variable refrigerant flow (VRF) system which employs a remote condensing unit and a separate multiple ceiling concealed indoor fan coil unit and interconnecting refrigerant distribution piping.

.2 Unit must be rated in accordance with ANSI/AHRI 1230 2010 and meet all minimum IEER performance requirements as per equipment schedule.

.3 The units shall be ANSI/UL STD 1995 listed and listed by Electrical Testing Labs (ETL) and bear the cETL label.

.4 All wiring shall be in accordance with the National Electric Code (NEC).

.5 The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

.6 The system and the design shall be in compliance with CSA B52 Mechanical Refrigerant Code.

.7 Acceptable manufacturer: Daikin, Mitsubishi, LG or approved equal.

.8 Provide indoor fan coil unit with necessary fans, refrigerant coils, air filters, drain pan, condensate pumps and galvanized steel cabinet construction.

.9 The remote unit must be as specified in Condensing Unit section below.

2.2 SYSTEM DESCRIPTION

.1 VRF system shall automatically vary the target evaporating and condensing temperatures based on building load and weather conditions to increase part load efficiency (Variable Refrigerant Temperature). The condensing unit shall also feature customizable operating modes which allows for the manual setting of target evaporating and condensing temperatures.

.2 System shall be a two-pipe heat pump switchover VRF system. All indoor units on single refrigerant circuits shall operate in the same mode (heating or cooling). The specified system is not a simultaneous heating and cooling heat recovery system. Refer to the controls section of this specification for any central controller and/or mode switchover sequence that may be required.

2.3 Refrigerant distribution piping

.1 Refer and comply to the refrigerant piping specifications, including the special considerations for VRF refrigerant piping section.

.2 Standard T style joints are **not acceptable** for a variable refrigerant volume system. Manufacturer specific Y joints shall be supplied by the VRF system manufacturer.

2.4 Indoor fan coil unit

.1 Indoor fan coil unit shall be a built-in ceiling concealed fan coil unit with variable speed direct drive DC type fan and auto CFM adjustment at commissioning.

.2 Casing shall be constructed of galvanized steel.

.3 Configuration shall be horizontal discharge air with horizontal return air, and be designed to fit in tight ceiling plenums

.4 The indoor unit's sound pressure shall range from 28 dB(A) to 36 dB(A) at low speed measured 5 feet below the ducted unit.

.5 The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump shall provide up to 25" of lift from the center of the drain outlet and have a built-in safety shutoff and alarm.

.6 The fan shall have a variable speed direct drive DC motor with statically and dynamically balanced impeller with 3 user-selectable fan speeds. The automatic fan speed mode shall allow the fan to vary between 5 speeds based on space load. The unit shall have logic for automatically adjusting external static pressure settings of the fan motor (selectable during commissioning).

.7 The unit shall ship from the factory in a rear return configuration and shall be field convertible to a bottom return configuration.

.8 Field installed MERV8 filters and filter kits with 2" or 4" filter depths.

2.5 Condenser unit

.1 Each riser stack will have its own independent VRF system

.2 The condensing unit shall be factory assembled in North America and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of inverter scroll compressors, motors, fans, heat exchanger, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver (heat recovery only) and suction accumulator.

.3 The system will automatically restart operation after a power failure and will not cause any settings to be lost.

.4 The unit shall incorporate an auto-charging feature to ensure proper refrigerant charge.

.5 The following safety devices shall be included on the condensing unit: high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter, and anti-recycling timers.

.6 The inverter scroll compressors shall be high efficiency reluctance digitally commutating, hermetically sealed, variable speed type. Temperatures and pressures shall be read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value. Non-inverter-driven compressors shall not be accepted.

.7 The variable speed inverter compressors shall also use flash vapor injection technology with back pressure control for reduced leakage and additional balancing weights on main shaft for increased for increased compressor lifetime

.8 Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. Upon complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

.9 The compressors' motors shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.

.10 Inverter board shall be refrigerant cooled to prevent inefficient and unstable operation that can result from air-cooled inverter boards due to varying ambient conditions.

.11 The compressor shall be internally isolated to avoid the transmission of vibration.

.12 In the case of multiple condenser modules, operation hours of the compressors shall be balanced by means of the duty cycling function.

.13 The fan motor shall have inherent protection and permanently lubricated bearings. The motor shall be provided with a fan guard to prevent contact with moving parts. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a digitally commutating inverter

.14 Motors shall be capable of delivering design air at high external static pressures up to 0.32 in WG (factory set as standard at 0.12 in. WG) to accommodate field applied condensing unit discharge ductwork.

.15 The condensing unit shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.

.16 Night setback control for low noise operation shall automatically limit the maximum speed of the fan motor.

.17 The fins are to be covered with an anti-corrosion hydrophilic blue coating as standard with a salt spray test rating of 1000hr (ASTM B117 & Blister Rating:10), Acetic acid salt spray test of 500hr (ASTM G85 & Blister Rating:10).

.18 The connection ratio of indoor units to condensing unit shall be permitted and optimized for operation up to 200% of nominal capacity.

2.6 Unit controls (LOCAL)

.1 Fan coil units shall be supplied with individual zone controllers.

.2 Zone controllers shall be hard wired by installing contractor.

.3 Controllers shall be able to function as follows:

i. The controller shall have single and dual setpoints for occupied periods, and independent setback setpoints for unoccupied periods.

ii. The controller shall have the ability to digitally prohibit individual buttons and functions, including custom mode selection.

iii. The controller shall have a self diagnosis function that constantly monitors the system for malfunctions.

iv. The controller shall be equipped with a thermostat sensor.

2.7 Unit controls (central)

.1 Provide an advanced multi-zone controller for installation in a common area as shown on the plans, equal to Daikin iTouch Manager. The controller shall have a 10” LCD touch screen display with the following screen views and functionalities:

.1 Central control of set points

.2 Schedules

.3 Fan speeds

.4 Heat/cool mode

.5 Setback (override) temperature settings during unoccupied periods.

.2 Adjustable temperature limits to restrict local wall mounted thermostat setpoint ranges.

.3 Visible and audible alarm indication of any system malfunctions with error code.

.4 Tiered hierarchy allowing for control of fan coil units independently or as a group.

.5 Remotely disable individual functions of the wall mounted zone controllers.

.6 Web enabled for remote access from PC, tablet or portable device and automatic alert and error emails.

.7 The following two automatic changeover methods shall be available. One shall be selected upon commissioning:

.1 Averaging Method – the central controller shall sum up the difference between room temperatures and set points for all indoor units in the system. Once this delta reaches the primary changeover deadband of ± 2°F (adjustable), the central controller shall change over the system automatically.

.2 Voting Method – The central controller shall evaluate the difference between individual room temperatures and set points, and only include a fan coil in the algorithm if the difference has passed the primary dead band for more than the guard timer, or past the secondary dead band. Heating priority option shall be available.

.8 For both automatic changeover options, a weight (0-3) can be added to each indoor unit. The automatic changeover algorithm shall use this weighting to prioritize changeover for the more heavily weighted fan coils.

.9 Upon any changeover, a guard timer shall prevent another changeover for a period of 15, 30, or 60 (default) minutes.

.10 The guard timer shall be ignored by a change of setpoint manually from either the central controller or the remote controller, by schedule, or if the secondary deadband is reached with either of the automatic changeover algorithms. The secondary changeover deadband shall be the sum of the primary changeover deadband (adjustable) ± 1°F (adjustable).

.11 “3D” Floor plan graphic layout

.12 The central controller shall have the capability for site floor plans to be uploaded as a background to create a graphics interface. Background shall be project specific floor plans rendered in “2D” or “3D”.

.13 Floor plan layout shall be displayed both on the local central controller, as well as accessible from the web.

.14 Floor plan will include capability to control indoor unit, and auxiliary inputs / outputs, such as designated lighting control, as follows:

.1 Up to 4 status points to be assigned to the control point icon (room name, room temperature, set point, and mode).

.2 Status and control points to display on corresponding location of zone served on floor plan.

.3 Digital input and output icons will display On/Off status.

.4 Analog input icons will display analog value.

.15 Up to 60 floor layout sections shall be possible depending on project scope.

.16 Centralized controller shall be complete with power distribution software with the ability to generate .csv files with power consumption data for each fan coil in the system. The software shall have the ability to assess how the power consumption of the condensing units shall be distributed to each fan coil. The energy consumption files shall be accessible from the web via a restricted security access.

.17 Power meters, provided by others, shall be approved for use by VRF manufacturer.

2.8 Electrical

.1 Independent electrical power for fan coils and branch selector boxes shall be 208/230 volts, 1 phase, 60 hertz. The unit shall be capable of operating within the limits of 187 volts to 253 volts.

.2 Unless limited by local electrical codes and standards, multiple fan coils and branch selector boxes can be connected to the same breaker. Field provided individual disconnect switches for each fan coil are required.

.3 **Selection:** Electrical power for condensing units shall be 575 volts, 3 phase, 60 hertz.

.4 **Selection:** Electrical power for condensing units shall be 208/230 volts, 3 phase, 60 hertz. The unit shall be capable of operating within the limits of 187 volts to 253 volts.

.5 The control voltage between the indoor and outdoor unit shall be 16VDC. The control wiring shall be communication type stranded non-shielded 18-2 AWG.

.6 Control wiring shall be installed in a daisy chain configuration between all VRF components as per Manufacturer.

2.9 Performance

.1 Unit sizes and performance shall be as noted in the schedule.

PART 3 Execution

3.1 Manufacturer’s instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Perform work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1 and ASME BPVC SEC IX, the design, fabrication, and installation of the system must conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Provide refrigeration equipment conforming to ASHRAE 15 & 34.

.4 Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items.

.5 Isolate compressors from the building structure. If mechanical vibration isolators are not provided, provide vibration absorbing foundations. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 150 mm 6-inch concrete pad doweled in place.

.6 Install condensing units on a flat surface level within 1/8 inch and elevated a minimum of 18” from ground or roof surface. Provide intermediate supports as recommended by the equipment manufacturer. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to 20-40 percent at lowest equipment rpm.

.7 Provide for pipe movement during normal operation.

.8 Maintain sufficient clearance to permit performance of service maintenance.

.9 Check final location with Owner’s Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request, and follow Owner’s Representative’s directive.

.10 Clean fins and comb straight.

3.3 Cleaning

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 General

.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1, Division 23, Division 27, Division 28, Division 33 and Division 34. Refer to Section 01 00 00 – Bid Depository Sections where applicable for bid depository.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

1.3 SUBMITTALS

.1 Submit drawings stamped and signed by professional engineer.

1.4 Permits, Fees and Inspection

.1 Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Owner's Representative will provide drawings and specifications required by Electrical Inspection Division and Supply Authority at no cost.

.4 Notify Owner's Representative of changes required by Electrical Inspection Division prior to making changes.

.5 Furnish Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of work to Owner's Representative.

1.5 co-ordination

.1 Co-ordinate work with work of other divisions to avoid conflict.

.2 Locate distribution systems, equipment, and materials to provide minimum interference and maximum usable space.

.3 Locate all existing underground services and make all parties aware of their existence and location.

.4 Where interference occurs, Owner's Representative must approve relocation of equipment and materials regardless of installation order.

.5 Notwithstanding the review of shop drawings, this division may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination by this Division. The cost of this relocation shall be the responsibility of this Division. The Owner's Representative shall decide the extent of relocation required.

1.6 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark all live parts "LIVE 120 VOLTS", or with appropriate voltage in English.

1.7 Record drawings

.1 Obtain and pay for three sets of white prints. As the job progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each job meeting.

.2 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.

.3 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.

.4 Submit record drawings within 30 days prior to start of commissioning.

.5 On completion of the project, electrical contractor shall request Electrical AutoCAD drawing for preparation of AS built drawings. Transfer all red-line mark up onto AutoCAD drawing to reflect AS built condition. Submit the electronic copy to engineer for review and approval.

.1 Final As Built drawing shall include following information:

.1 All revisions during construction.

.2 All Emergency feeders route and exterior underground feeders routes.

.6 If required, Engineer's Representative can produce the final AS built drawing in CAD at electrical contractor's expense of $200.00 per sheet. Contractor shall provide red-line mark up drawing to Engineer's representative for preparation.

1.8 Shop Drawing submittal

.1 Shop drawing shall indicate the materials and/or equipment being supplied, all details of construction, accurate dimensions, capacity, operating characteristic and performance.

.2 Submit shop drawing electronically, by email, in PDF format. Scanned PDF is not acceptable.

.3 All shop drawings shall include the contractor's stamps and signed by contractor to indicate all shop drawings have been reviewed by the contractor and all requirement per contract documents have been reviewed and in conformance prior to submission to electrical consultant for review.

.4 Equipment shall not be released to manufacture for purchasing until shop drawing has been reviewed by electrical consultant. Otherwise, Contractor shall assume responsibility and cost incur for the purchase equipment resulting design change/installation change.

1.9 INSPECTION OF WORK

.1 The Owner will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.

1.10 SCHEDULING OF WORK

.1 Work shall be scheduled in phases as per other divisions of the architectural specifications.

.2 Become familiar with the phasing requirements for the work and comply with these conditions.

.3 No additional monies will be paid for contractor's requirement to comply with work phasing conditions.

1.11 Valuation of Changes

.1 Contractor shall provide the Engineer's Representative with a detailed cost analysis of the contemplated change indicating:

.1 Quantity of each material.

.2 Unit cost of each material.

.3 Time involved.

.4 Sub-trade quotations including a complete analysis of costs.

.5 Mark-ups, if applicable.

.6 Value of GST or HST, as applicable.

.7 Proposed change in Contract Time.

.2 The detailed cost breakdown is to list material and labour separately for each item on the proposed change.

.3 The following shall not be included in the cost of the work but are covered by the allowance (mark-ups) for overhead and profit:

.1 The Contractor's payroll, administrative, head office and site office expenses, including stationary, postage and other office supplies.

.2 The costs of the Contractor's Project Manager, clerical and administrative personnel, and executive personnel.

.3 Use of temporary offices, sheds, small/hand tools, storage, and site office consumables, etc., including but not limited to the cost of telephone, light, power, water and heat used therein.

.4 Transportation and overnight room expenses for out of town labour, if local labour is unavailable.

.5 Insurance premiums, all government payroll burdens, variable labour factors and union or association funds.

.6 Licenses and permits, except when these are special for a particular item of work.

.7 Printing charges for Proposed Changes, Change Orders and Drawings for Contractor's and Subcontractors' use in the work. Engineer's Representative will provide a PDF electronic copy of change notice documentation.

.8 The cost of preparing record, layout and working drawings and shop drawings.

.9 The cost of clean-up and disposal of waste material.

.10 Parking, travel, coffee break/rest periods, warranties, safety training, WHMIS and health and safety committee, and non-productivity time.

.11 Rentals, additional bonding, project financing.

.12 Product receiving and transportation.

.4 The Contractor may apply markups for overhead and profit to approved changes as follows:

.1 10% for work carried out by the Contractor's own forces; and

.2 7% for work carried out by Subcontractors.

.5 Similarly, Subcontractors may apply markups for overhead and profit as follows:

.1 10% for work carried out by their own forces; and

.2 7% for work carried out by subcontractors.

.6 During the duration of the electrical contract, extra work hourly labour units are to be based on the latest edition of the National Electrical Contractors Association (NECA) labour units column 1(one). No additional factors will be accepted.

2 Products

2.1 Materials and Equipment

.1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment, which is not CSA certified, obtain special approval from Electrical Inspection Division.

2.2 Warning Signs

.1 As specified and to meet requirements of Electrical Inspection and Owner's Representative.

.2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

2.3 Conduit and Cable Identification

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

2.4 equipment identificaiton

.1 Identify electrical equipment with lamacoid labelled nameplates.

.1 Name plate shall be black with minimum 19mm high white engraved letter.

.2 Name plate shall be provided for all electrical equipment, but not limited to following:

.1 Electrical distribution equipment, such as switchboard, distribution panel, splitter, disconnect switch, branch panels, receptacle, etc.

.2 Dry type transformers

.3 Control devices, such as starter, contactors, etc.

.4 Mechanical equipment

.5 Generator & automatic transfer switch.

.3 Nameplate for switchboard, electrical distribution equipment shall indicate the name of the equipment, rated ampacity, voltage, phase, number of wires and source of power.

.4 Name plate for Automatic Transfer switch - ATS shall indicate ampacity, voltage, transfer switch arrangement, kA rating, upstream source of normal power and Emergency power.

.5 Name plate for control devices shall indicate the equipment that's controlling

.6 Name plate for transformer shall indicate primary and secondary voltage and the source of the power.

.7 Name plate for disconnect switch/breaker within switchboard/distribution panel shall indicate the label of equipment that is protecting.

.8 Mechanical equipment: indicate equipment name and full circuit number including panel board identification

.9 All receptacles are to be labelled with the respective circuit numbers with a printed label, similar to a Brady label, with 12mm characters. Circuit number to include full circuit number including panel board identification.

.10 Generators:

.1 Indicate kW rating, kVA rating, voltage, number of phases, number of wires, generator neutral grounding arrangement, year and month manufactured, and engine and alternator serial number.

.2 The interior and lids of all junction boxes and outlets boxes shall be neatly identified with different colours of paint. The colours shall be consistent throughout the project for the following system:

.1	347/600 Volt System	Black
.2	120/208 Volt System	Blue
.3	347/600 Volt System	Green
.4	120/208 Volt Emergency System	Orange
.5	Fire Alarm System	Red
.6	Security system	Grey

2.5 Plywood Backboards

.1 Provide fire rated plywood backboards for all surfaced mounted panel on the drawing. Plywood to be 21mm, UF free and shall be FSC/SFI/CSA Z809 certified. Plywood shall be fire rated/coated with fire retardance paint.

2.6 HOusekeeping pads

.1 Provide concrete housekeeping pads under all floor mounted electrical equipment and as indicated on the drawing. Housekeeping pads shall be minimum 100mm high above finish floor and 78mm beyond electrical equipment.

3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Provide typed print panel directory for all panels at the end of construction.

3.2 Conduit and cable installation

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.4 Trips, relays and fuses are installed to required values and settings.

3.3 Meggering and balancing

.1 Megger all power circuit feeders. If ground resistance on any circuit is less than that required by CSA or other governing regulations, such circuits are to be considered defective and must be replaced.

.2 Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and submit a report for insertion into manuals.

3.4 FIELD QUALITY CONTROL

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentice’s program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.2 The work of this division to be carried out by a contractor who holds a valid Code 1 Electrical Contractor License as issued by the Province.

.3 Furnish manufacturer’s certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer’s instructions.

3.5 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results for Electrical.

PART 2 Products

2.1 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centre line of equipment unless noted otherwise.

.2 Verify with the Consultant before proceeding with installation if mounting height of equipment is not specified or indicated.

.3 Unless noted otherwise on the drawings or within the specifications, installed equipment at following heights:

- .1 Local Switches: 1050mm
- .2 Wall receptacles:
  - .1 General: 450mm
  - .2 Above top of continuous baseboard heater: 200mm
  - .3 Above top of counters or counter splash backs: 175mm
  - .4 In mechanical rooms: 1200mm
  - .5 In equipment storage rooms: 900mm
- .3 Panelboards: 2000mm to top of panel
- .4 Telephone and interphone outlets: 450mm
- .5 Wall mounted telephone and interphone outlets: 1050mm
- .6 Fire alarm stations: 1100mm
- .7 Wall Mounted Fire alarm audible devices: 2300mm
- .8 Television outlets not mounted behind a wall mounted television: 450mm
- .9 Wall mounted speakers: 2100mm
- .10 Clocks: 2100mm
- .11 Power Door Operator Pushbuttons: 1050mm
- .12 Wall mounted Exit Signs
  - .1 For 2400mm to 2500mm ceiling heights: 2100mm
  - .2 For all ceilings heights greater than 2500mm: 2400mm
- .13 Wall mounted Battery Packs and Emergency Heads
  - .1 For 2400mm to 2500mm ceiling heights: 2100mm
  - .2 For all ceilings heights greater than 2500mm: 2400mm
- .14 Wall mounted occupancy sensors: 1050mm
- .15 Wall mounted visible signal devices: entire lens shall be no less than 2000mm and no more than 2400mm

.16 Top of remote annunciator and passive graphic panels shall be no more than 1800mm above finished floor.

.17 Wall mounted emergency telephone (Fireman's Handset): 1350 to 1500mm

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results for Electrical.

1.2 number of copies

.1 Provide minimum of six (6) copies of Electrical Maintenance Manuals.

.2 Provide soft copy in PDF format of the Electrical Maintenance Manuals.

1.3 SCHEDULE

.1 Electrical Maintenance Manuals shall be delivered to the Consultant 30-days prior to the start of the Operator Training.

1.4 DELIVERY

.1 Manuals to be bound in a hard cover neatly labeled: "OPERATING AND MAINTENANCE INSTRUCTIONS".

1.5 SPARE PARTS

.1 Manuals shall include recommended spare parts and consumables for start up, commissioning, first six months of operation and yearly maintenance requirements.

1.6 FORMAT

.1 Manuals shall be provided to identify the overall system requirements as well as identifying individual components.

.2 The information included within the manuals shall be for the equipment that was supplied to the project site. Where the shop drawings indicate multiple features that can be provided with the equipment, they shall be marked up to show exactly what was provided.

.3 Provide the Operating and Maintenance manuals that are supplied with the Equipment.

.4 Any deviations that were made to the equipment that is not consistent with what is shown on the shop drawings shall be clearly identified in the Maintenance Manuals. The item that has not been installed shall be crossed out and the item that has been installed shall be inserted into the drawings.

.5 Where equipment is wired together as a system a control schematic drawing shall be provided showing how all of the devices are interconnected including terminals and labeling.

.6 Where equipment is electrically connected together as a system a schematic drawing or single line shall be provided showing how all of the devices are electrically connected together.

1.7 MANUFACTURER'S START UP REPORTS

.1 The manufacturer's start up reports shall be included in the maintenance manuals with each system.

.2 Include manufacturers follow up reports for all issues identified in the start up reports.

1.8 FACTORY TESTING

.1 Reports generated by factory testing of the equipment prior to shipment to site shall be included with the applicable piece of equipment shop drawing.

1.9 SERVICE AGREEMENTS

.1 Include any service agreements and their length that are part of the contract.

1.10 Equipment Data

.1 Equipment data shall contain:

- .1 Location of equipment.
- .2 Operating instructions.
- .3 Operating conditions around equipment such as temperature and pressure.
- .4 Maintenance instructions and schedules for a minimum one-year period.
- .5 Recommended list of spare parts.
- .6 Maintenance schedule.
- .7 A trouble shooting table showing where to look for problems under various conditions of malfunction.
- .8 All wiring diagrams.
- .9 Equipment operating curves.
- .10 Equipment nameplate data and serial numbers.

.2 Equipment data shall contain:

- .1 A listing of all systems.
- .2 All distribution equipment, lighting and fire alarm schedules and locations.
- .3 Equipment name tags.
- .4 Cleaning, maintaining and preserving instructions for all material, products and surfaces. Include warnings of harmful cleaning, maintaining and preserving practices.

1.11 SPARE PARTS

.1 Provide a list of spare parts provided for the building. List shall be organized by category.

.2 From the Manufacturer's Maintenance Manuals identify recommended spare parts for each piece of equipment/system.

.3 Identify any spare parts that were turned over to the Owner as part of the Contract.

1.12 WARRANTIES

.1 Provide a warranty letter from the Contractor within the Maintenance Manuals.

.2 For any equipment that has an extended warranty include the Manufacturer's warranty with the equipment shop drawing and identify the date of the extended warranties expiration.

1.13 MAINTENANCE

.1 The maintenance requirements for each piece of equipment shall be taken from the Manufacturer's Operation and Maintenance Information.

.2 Provide a summary page for each piece of equipment which identifies the following:

.1 Daily Maintenance
.2 Weekly Maintenance
.3 Monthly Maintenance
.4 Semi Annual Maintenance
.5 Annual Maintenance
.6 As Required Maintenance.

PART 2 EXECUTION

2.1 FORMAT

.1 Maintenance manuals shall be divided into sections with neatly labeled and tabbed dividers between each section.

.2 Each binder shall include a table of contents.

2.2 SECTION 1 – GENERAL

.1 Section 1 shall include the following:

.2 A list giving name, address and telephone number of the following:

.1 Consultant
.2 Engineers
.3 Construction Manager
.4 Electrical Trade
.5 Electrical Sub Trades
.6 Mechanical Sub Trade where applicable

.3 Provide documentation indicating when Operator Training took place and who was present at the Training.

2.3 SECTION 2 – WARRANTIES AND SHOP DRAWINGS.

.1 Include a list giving the name, address and telephone number of all suppliers.

.2 A copy of the Contractor's Warranty letter.

.3 A copy of all approved shop drawings for all equipment. Provide a tab with each shop drawing to identify the relevant section of the specification that the equipment is associated with.

.4 The Contractor shall include a report which identifies any deviations from the approved shop drawings that occurred on site. The report shall also identify any field installed components (transformers, relays, switches) that do not appear on the shop drawings.

2.4 SECTION 3 – Switchboards and power distribution systems.

.1 This section shall be organized by system. Systems shall include:
- .1 Switchboards.
- .2 Distribution Panels
- .3 Lighting Panels
- .4 Receptacle Panels
- .5 Disconnect Switches
- .6 Transformers
- .7 Contactors
- .8 Fuses
- .9 Grounding Systems

.2 A system description shall be provided for each system. The description shall include the following:
- .1 System Type
- .2 Areas Served
- .3 Function of Major Components
- .4 Location in Building
- .5 A system schematic shall be provided for each system.
- .6 Electrical nameplate ratings

.3 Operating Instructions shall be included. They shall include:
- .1 Type and specific location of each device used in the system operation.
- .2 Include Manufacturer's Equipment Start Up Sheets for Each System.
- .3 Include Warranty information for each piece of equipment where warranty extends beyond standard one year.
- .4 Include maintenance tasks and schedules for the system.
- .5 Field Test certificates and reports for all distribution equipment.

.6 Provide a copy of all Authorities Having Jurisdiction inspection and test reports.

.7 Include a copy of all operational tests that were performed.

.4 Include a copy of all Equipment Factory Test Reports

2.5 SECTION 4 – Lighting systems

.1 This section shall be organized by system. Systems shall include:

.1 Light Fixtures

.2 Lamps

.3 Ballasts

.4 Drivers

.5 Lighting Controls System

.6 Switches

.2 A system description shall be provided for each system. The description shall include the following:

.1 System Type

.2 Areas Served

.3 Function of Major Components

.4 Location in Building

.5 Electrical Nameplate Ratings

.3 A system schematic shall be provided for each system.

.4 Operating Instructions shall be included. They shall include:

.1 Type and specific location of each device used in the system operation.

.2 Identify safety devices and interlocks that must be satisfied in order for the system to start.

.3 Operation of Equipment when building is operating on emergency power.

.4 Include Manufacturer's Equipment Start Up Sheets for Each System.

.5 Include Warranty information for each piece of equipment.

.6 Include maintenance tasks and schedules for the system.

.7 Include a copy of all operational tests that were performed.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.

.2 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for copper bar.

.3 Stud clamp bolts.

.4 Bolts for copper bar.

.5 Sized for conductors and bars as indicated.

.4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

PART 1 General

1.1 Related Sections

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

.2 Refer to drawings for wiring type required under different applications.

1.2 References

.1 Canadian Standards Association (CSA)

- .1 CSA C22.2 No .0.3 (latest edition), Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.
- .3 CSA C22.2 No.38 (latest edition), Thermoset-Insulated Wires and Cables
- .4 CSA C22.2 No. 75 (latest edition), Thermoplastic-Insulated Wires and Cables
- .5 CSA-C22.2 No. 51 (latest edition), Armoured Cables
- .6 ASTM B800 - Standard Specification for 8000 Series Aluminium Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers

PART 2 Products

2.1 Building Wires

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper and ACM alloy conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE as indicated. Provide RWU90 XLPE rated cable for underground wiring. Related to new service entrance feeders and site lighting circuits. RWU90 XLPE not required under interior floor slabs.

.3 Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V, typically used for insulated ground wires.

.4 Contractor to provide copper conductors on conductors sizes up to and including #8 AWG. Contractor to provide copper conductors for sizes larger than #8AWG unless identified as aluminium or NUAL on the drawings.

.5 All conductors to have size as indicated, with insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90 to CSA C22.2 No.38 or heat and moisture-resistant thermoplastic polyvinyl chloride (PVC) insulation with an outer nylon jacket rated T90 to CSA C22.2 No.75 rated as follows:

.1 Insulation rated at 600V for the other 600 V and 347/600 V distribution systems.

.2 Insulation rated at 600V for all systems rated at 600 V and less.

.6 All aluminium or NUAL conductors to be an aluminium alloy with CSA certified as an Aluminium conductor material (ACM) and meet the requirements of the Aluminium Association Inc AA8030 and ASTM B800 standards.

.7 RWU-90 wiring shall be used for underground installations.

2.2 TECK Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated unless aluminium or NUAL is identified on the drawings. Aluminium or NUAL conductor to be provided as per item 2.1.7.

.3 Insulation:

.1 Chemically cross-linked thermosetting polyethylene type RW90, rated 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum, compliant to applicable Building Code classification for this project.

.6 Overall covering: thermoplastic polyvinyl chloride material rated at a minimum of FT-4. Provide FT-6 jacket when TECK cables are run in return air plenum.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1500 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight and/or type approved for TECK cable, as indicated.

2.3 Mineral-Insulated Cables

.1 Conductors: solid bare soft-annealed copper, size as indicated.

.2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.

.3 Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.

.4 Overall jacket: PVC applied over the sheath and compliant to applicable Building Code classification for this project for direct buried and wet locations, as indicated.

.5 Two hour fire rating.

.6 Connectors: watertight, field installed, approved for MI cable.

.7 Termination kits: field installed approved for MI cable.

.8 Conform to requirements of CSA C22.2 # 124; and ULC S 139

2.4 Armoured Cables

.1 Cables to: CSA-C22.2 No. 51 (latest edition).

.2 Circuit conductors: copper, size as indicated unless aluminium or NUAL is identified on the drawings. Aluminium or NUAL conductor to be provided as per item 2.1.7.

.3 Type: AC90 (BX).

.4 Armour: interlocking type fabricated from aluminium strip.

.5 Type: ACWU90 - PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No.0.3 with maximum flame travel of 1.2 m (3 ft. 11 in.).

.6 Connectors: standard as required, complete with anti-short rings.

2.5 Control Cables

.1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket. Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40° C polyethylene insulation with shielding of tape coated with paramagnetic material wire braid over each conductor and overall covering of PVC jacket.

2.6 Aluminum Sheathed Cable

.1 Circuit conductors: copper, size as indicated unless aluminium or NUAL is identified on the drawings. Aluminium or NUAL conductor to be provided as per item 2.1.7.

.2 Insulation: type RA90 rated 1000 V.

.3 Sheath: aluminium applied to form continuous corrugated seamless sheath.

.4 Outer jacket of PVC applied over sheath for direct burial or wet locations.

2.7 ACM Conductors

.1 Annealed, compacted aluminum alloy conductor material (ACM) for circuits 60 amps or more, single or multi-conductor, 600 V insulation where indicated.

.2 Type: AC90, ACWU90 and TECK90.

.3 Armour: interlocked aluminum strip.

.4 Conductivity: 61% IACS to that of copper.

.5 Outer jacket: ACWU90 PVC jacket, FT-4 rated suitable for direct buried and Div. 1 and Div. 2 hazardous locations.

2.8 VARIABLE FREQUENCY DRIVE CABLES

.1 Variable frequency drives are also known as variable speed drives.

.2 Cables to CAN/CSA-C22.2 No. 123-96 and CAN/CSA-C22.2 No. 174 (latest edition).

.3 Conductors:

.1 Three (3) bare grounding conductor coppers sized in accordance to the Canadian Electrical Code.

.2 Circuit conductors: copper, size as indicated.

.4 Insulation:

.1 Chemically cross-linked thermosetting polyethylene type RW90, rated 1000 V.

.5 Inner jacket: polyvinyl chloride material.

.6 Armour: interlocking aluminum.

.7 Overall covering: thermoplastic polyvinyl chloride (PVC) material rated at a minimum of FT-4

PART 3 Execution

3.1 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Owner’s Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 No splices permitted in panel board feeders in new construction. Splices in re-work or renovation projects only with pre-approval by Owner’s Representative.

3.2 General Cable Installation

.1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.

.3 Bonding conductors shall be sized per OESC latest edition.

.4 Provide a minimum of one grounding wire for each three ungrounded conductors on all conduit and cable runs. Size grounding in accordance to the Canadian Electrical Code. Provide separate grounding conductors for each ground fault circuit interrupter circuits. All bonding conductors to be copper and insulated with a green coloured insulation.

.5 All equipment to be grounded through ground wires.

.6 Provide a variable frequency drive (VFD) cable from each VFD unit to each motor. Wiring to be installed in accordance with the VFD and motor manufacturer instructions.

.7 All cable terminations to be compression or mechanical screw type fittings for wire sizes greater than #8 AWG. All compression type fittings to be two-hole long barrel type. Where mechanical screw type lugs are used, they will be suitable for quantity of parallel runs of wire that are to be terminated under.

.8 The maximum allowable distance of armoured cable is 3 m. Contractor to receive written approval from the Consultant to run armoured cable further than 3m. Wiring in conduit is to be brought to a junction box to allow for the transition to armoured cable. Armoured cable is not to be installed directly into electrical panels.

.9 Branch circuit: Copper. Straded for No. 12 AWG and Larger

.10 Minimum branch wire size shall be 12 Awg and #14 AWG for Control wiring. Conductor size shall be upsized to #10 AWG or larger if the entire length of the circuit wiring exceeds 100ft. Conduct voltage drop calculation to ensure no more than 3% voltage drop between feeder and branch circuits.

.11 Wire Splicing

- .1 Splice up to and including No. 6 AWG with nylon insulated expandable spring type connectors.
- .2 Splice larger conductors using compression type connectors wrapped in PVC insulation rated at the respective voltage.

.12 Conductor length for parallel feeders to be identical.

.13 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.14 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.15 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.16 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.17 MI cable shall be installed in accordance with manufacturer's installation manual.

3.3 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34- Conduits, Fastenings and Fittings.

.2 In cable troughs in accordance with Section 26 05 33.01- Cable Trays for Electrical Systems.

.3 In underground ducts in accordance with Section 26 05 43.01- Installation of Cables in Ducts.

.4 In trenches in accordance with Section 26 05 43.01- Installation of Cables in Trenches.

.5 In underfloor distribution system in accordance with Section 26 05 39- Underfloor Raceways for Electrical Systems

.6 In cellular floor raceways in accordance with Section 26 05 38 – Cellular Metal Floor Raceway Fittings.

.7 In surface and lighting fixture raceways in accordance with Section 26 50 00- Lighting.

.8 In wireways and auxiliary gutters in accordance with Section 26 05 37 – Wireways and Auxiliary Gutters.

.9 Overhead service conductors in accordance with Section 26 24 01 - Service Equipment.

.2 Install all building wiring in conduit unless otherwise noted. Conduit to be sized to the Canadian Electrical Code unless noted on the drawings or in the specifications.

.3 All conductors are to be colour coded. Provide colour tape at all terminations to identify all conductors in each run.

3.4 Installation of TECK Cable 0 -1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with manufacturer's instructions.

.3 Fastenings:

.1 One-hole steel straps to secure surface cables 50 mm (2 in.) and smaller. Two-hole steel straps for cables larger than 50 mm (2 in.).

.2 Channel type supports for two or more cables.

.3 Galvanized threaded rods: 6 mm (1/4 in.) dia. minimum to support suspended channels.

.4 Connectors:

.1 Watertight, approved for respective cables.

3.5 Installation of Mineral-Insulated Cables

.1 Handling:

.1 Cable shall be uncoiled by rolling or rotating supply reel. Do not pull from coil periphery or centre.

.2 Bending:

.1 Not less than six (6) times the cable diameter for cable not more than ¾ in. (250 kcmil).

.2 Not less than twelve (12) times the cable diameter for cable diameter for cable more than ¾ in. (350 and 500 kcmil).

.3 Splicing:

.1 All fire rated splices shall be made in the factory. In the event of a field splice is necessary, it must be made in the field by manufacturer's field technician.

.4 Terminations:

.1 Field made terminations shall be made with cable manufacturer's termination kits only. Stripping tools, crimping and compression tools available from the manufacturer shall be used for proper cable termination.

.2 Connections to ferrous cabinets for single conductor cables shall incorporate brass plates. Installed per manufacturer's drawing.

.3 At cable terminations use thermoplastic sleeving over bare conductors.

.5 Sheath induction reduction:

.1 When multi-phase circuits have paralleled single conductors, cables shall be run in groups having one of each phase in each group.

.2 Each set of paralleled conductors shall be separated by at least two single cable diameters.

.6 Exposed or Surface Installations:

.1 Cable shall be secured directly to fire rated building structure using:

.1 Straps: 13 mm (½ in.) wide x 38 mm (3½ in.) long by 0.75 mm (1/32 in.) thick stainless steel or copper straps. Each strap shall contain two 5 mm (¼ in.) holes for securing with 5 mm (3/16 in.) by minimum 44 mm (1-3/4 in.) long steel anchors.

.2 Support 2 hr fire rated cables at 1 m (3 ft. 3 in.) intervals.

.7 Wall or floor penetrations:

.1 Provide approved fire stopping of all penetrations.

.2 Neatly train and lace cable inside boxes, equipment, and panel boards.

.3 Where cables are buried in cast concrete or masonry, sleeve for entry of cables.

3.6 Field Quality control

.1 Prior to Energizing cables, measure insulation resistance of each cable. Ensure readings are acceptable per Installation recommendations. Tabulate and submit for approval.

3.7 Installation of Armoured Cables (AC-90)

.1 Group cables wherever possible.

.2 Use permitted only for work in movable partitions and vertical power supply drops to lighting fixtures.

.3 Ensure all cables are terminated and made safe prior to ceiling grid being installed. All lighting drops to be terminated safely, with approved connectors, within an approved box, complete with cover.

3.8 Installation of Control Cables

.1 Install control cables in conduit.

.2 Ground control cable shield.

3.9 Installation of Non-Metallic Sheathed Cable

.1 Install cables.

.2 Install straps and box connectors to cables as required.

.3 Use permitted in wood stud construction only.

3.10 INstallation of ACM Conductors

.1 Install ACM cables as per the latest edition of the Canadian Electrical Code and manufacturers installation requirements.

.2 Do not terminate ACM conductors with a copper bodied connector.

.3 Apply oxide coating on base cables as per electrical code requirements.

END OF SECTION

PART 1 General

1.1 INSTALLATION TOOLS

.1 Include with the material one complete set of installation tools. Tools to include all hydraulic pumps, fittings, compression dyes, cutting tools, measuring devices necessary to install all components.

.2 Include AC-90 cable cutting tool (side cutters or back saws not permitted).

PART 2 PRODUCTS

2.1 15KV TERMINATION KIT FOR 1/0MCM 15KV CABLE

.1 Hydrophobic silicon body.

.2 High-K stress control.

.3 BIL rating 110 kV.

.4 Compatible with size 1/0 AWG stranded copper 15 kV cable.

.5 The exact kit selection will be based on the actual 1/0 AWG cable dimensions.

2.2 15KV CONNECTOR LUGS

.1 Suitable for use with a 1/0 AWG cable.

.2 The exact lug selection will be based on the actual 1/0 AWG cable dimensions.

2.3 TOOLS

.1 One Thomas and Betts TBM5 installing tool or approved equal.

.2 For 3M terminations - two 3M CPK-A tool kits or approved equal.

.3 AC-90 cutting tool.

PART 3 execution

3.1 installation

.1 Install terminations, and splices in accordance with manufacturer’s instructions.

.2 Bond and ground as required to CSA C22.2 No. 41.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

.2 Grounding conductors for all distribution grounding to be insulated copper, uninsulated where in contact with earth. Copper conductors shall, at a minimum, be used in the following areas: grounding of transformer neutrals, service entrance switch ground of neutral, padmount transformer grounding, ground rider conductors from main ground station to sub-closets, telephone and data system grounds and circuits rated less than 60 amps. Where type ACM conductors are used for circuits rated 60 amps or greater, type ACM bonding conductor is permitted.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA)

.1 CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities, where applicable.

PART 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.3 Rod electrodes: copper clad steel 19 mm dia by 3 m long.

.4 Plate electrodes: copper, surface area 0.2 m^2, 1.6 mm thick.

.5 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.6 Insulated grounding conductors: green, type TW.

.7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.8 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors, as required by local authority having jurisdiction.

.4 Thermit welded type conductor connectors, as indicated.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

PART 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run insulated copper ground wire in conduit.

.2 All metal equipment enclosures and other metal pipes, including but not limited to water pipe, gas pipe, ducts, etc. shall be connected to nearest ground bus.

.3 Connection equipment to building structural with ground wire is not acceptable. All equipment must be connected to ground bar.

.4 Install connectors in accordance with manufacturer's instructions.

.5 Protect exposed grounding conductors from mechanical injury.

.6 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.7 Use mechanical connectors for grounding connections to equipment provided with lugs.

.8 Soldered joints not permitted.

.9 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.10 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.11 Install separate ground conductor to outdoor lighting standards.

.12 Connect building structural steel and metal siding to ground by welding copper to steel.

.13 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.14 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.

.15 Ground secondary service pedestals.

3.2 MANHOLES

.1 Install conveniently located grounding electrode and size 3/0 stranded copper conductor in each manhole.

.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

3.3 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install rod, plate electrodes and make grounding connections.

.5 Bond separate, multiple electrodes together.

.6 Use size 2/0, 3/0 or 4/0 AWG copper conductors for connections to electrodes as required by code.

.7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 208 V system.

3.5 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.6 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size as required by code.

3.7 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.8 PERMAFROST

.1 Bond non-current carrying metal parts together with size 3/0 AWG copper equipotential conductor. Run conductor from separate lug or service neutral bar to, but not necessarily limited to, following indoor systems and equipment:

.1 Hot water heating system.

.2 Main water pipe.

.3 Main building drain.

.4 Oil line.

.5 Telephone, radio/tv, emergency and fire alarm lead-in or service conduits, near panels.

.6 Make connections to pipes on building side of main valves and tanks. Connect jumpers across boilers to supply and return hot water heating pipes.

.2 Drive three -19 mm diam x 3 m copper clad ground rods at least 1.8 m apart in original undisturbed ground. If rods will not penetrate permafrost, drive at angle not more than 60^{o} from vertical, and in same direction. Rods must be driven, not trenched.

.3 Install ground wire from service neutral bar to rods and where buried use bare copper not smaller than size 1AWG7- strand or size 4AWG solid, and at least 460 mm below ground. Bond ground conductor, or short tap from it, to outside metal sheathing of building close to power service conduit. Use lug or cast clamp, with bronze or plated bolt, nut and washers (not sheet metal screw or wood screw). Remove paint from sheathing for good contact. Conduit is required only on outside wall of building. Indoors, run bare and fasten as specified for equipotential bonding wire.

.4 Install electrode interconnections where metal parts, circuits or grounding conductors and/or electrodes are in proximity to lightning rod conductors.

3.9 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results. Contractor shall retain certified testing agency to conduct field testing and verification of entire building ground system before energizing electrical system.

Agency shall provide complete test reports for record and shall be included in final closeout document. All costs shall be included in bid.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Owner's Representative and local authority having jurisdiction over installation.

.3 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 General

1.1 Work included

.1 Conform to Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.2 Product Data

.1 Conduit and equipment provided under the Electrical division shall be complete with all necessary supports and hangers required for a safe and workmanlike installation.

PART 2 Products

2.1 Materials

.1 Provide “U” type support Strut as manufactures by Unistrut.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.4 Strap AC-90 cable at box location plus every 900 mm.

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing, wood blocking, plastic strap or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Owner’s Representative.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 General

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results – Electrical.

1.2 SUBMITTALS

.1 Submit shop drawings and product data for cabinets.

.2 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.

PART 2 Products

2.1 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 Junction and Pull Boxes

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3 Cabinets

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm fir plywood backboard for surface flush mounting.

PART 3 Execution

3.1 Splitter Installation

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes and Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.5 Ensure all electrical boxes above drywall ceilings are accessible via a properly sized access door installed directly below the box in drywall ceilings. Temporary removal of electrical light fixtures are not considered safe access to above ceiling electrical boxes and shall not be permitted.

3.3 Identification

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name voltage and phase.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.

.2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

.3 Section 26 05 34 – Conduits, Conduit Fastenings and Fittings.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.1, Canadian Electrical Code, Part 1.

PART 2 Products

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 galvanized Steel Outlet Boxes

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 Masonry Boxes

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Floor Boxes

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6 Conduit Boxes

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.7 Outlet Boxes for Non-metallic Sheathed Cable

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables. For use in wood stud construction only.

2.8 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

.5 Double split rings for AC-90 terminations.

2.9 Service Fittings

.1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation.

.2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two Amphenol jack connectors.

PART 3 Execution

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END OF SECTION

PART 1 General

1.1 References

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware, a National Standard of Canada.
- .2 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2, Rigid PVC (Un-plasticized) Conduit.
- .6 CAN/CSA C22.2 No. 227.3, Non-metallic Mechanical Protection Tubing (NMPT), a National Standard of Canada.

1.2 SUBMITTALS

.1 Product data: submit manufacturer's printed product literature, specifications and datasheets.

- .1 Submit cable manufacturing data.

.2 Quality assurance submittals:

- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.

PART 2 Products

2.1 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.5 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

.6 FRE conduit: to CSA C22.2.

.7 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3,

2.2 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.5 m oc.

.4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90°, 45 ° or 22.5 ° bends are required for 25 mm and larger conduits.

.3 Ensure conduit bends other than factory “ells” are made with an approved bender. Making offsets and other bends by cutting and rejoining 90 degree bends are not permitted.

.4 Connectors and couplings for EMT. Steel set-screw type, size as required.

2.4 Expansion Fittings for Rigid Conduit

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 Fish Cord

.1 Polypropylene.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 Install all conduit, conduit fittings and accessories in accordance with the latest edition of the Canadian Electrical Code in a manner that does not alter, change or violate any part of the installed system components or the CSA/UL certification of these components.

.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas. Allow for cutting, patching, and painting to suit.

.4 Surface mount conduits except in finished areas or as indicated.

.5 Use rigid hot dipped galvanized steel threaded conduit for exposed work below 2.4 m above finished floor.

.6 Use epoxy coated conduit underground in corrosive areas and where exposed to exterior elements. (ie: pole mounted service entrance conduits)

.7 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury, as well as concealed work in masonry construction.

.8 Use rigid PVC conduit underground and buried in or under concrete slab on grade.

.9 Use FRE conduit for encasement in concrete duct bank for service entrance feeders.

.10 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without a prewired outlet box connection to surface or recessed fluorescent fixtures work in movable metal partitions.

.11 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.12 Use AC-90 for vertical power supply drops to light fixtures.

.13 Use explosion proof flexible connection for connection to explosion proof motors.

.14 Install conduit sealing fittings in hazardous areas. Fill with compound.

.15 Minimum conduit size for lighting and power circuits: 19 mm. 12 mm conduit is acceptable for switch leg drops only where one two-wire circuit and ground is required.

.16 Install EMT conduit from computer room branch circuit panel to outlet boxes located in sub floor.

.17 Install EMT conduit from computer room branch circuit panel to junction box in sub-floor immediately below panel. Run flexible conduit from junction box to outlet boxes for each computer in sub-floor.

.18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.19 Mechanically bend steel conduit over 19 mm dia.

.20 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.21 Install fish cord in empty conduits.

.22 Run 2 - 25 mm spare conduits up to ceiling space and 2 - 25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.

.23 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.24 Dry conduits out before installing wire.

3.3 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 Conduits in Cast-in-place Concrete

.1 Locate to suit reinforcing steel. Install in centre one third of slab. Use rigid PVC conduit.

.2 Protect conduits from damage where they stub out of concrete. Use rigid steel conduit for stub-up and adapt to in floor rigid PVC conduit.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.6 Conduits in Cast-in-place Slabs on Grade

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.7 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.2 On Completion and verification of performance of installation, remove surplus materials, excess materials rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

- .1 CAN/CSA-A5-93, Portland Cement.
- .2 CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction.
- .3 CSA G30.3-M1983 (R1991), Cold-Drawn Steel Wire for Concrete Reinforcement.
- .4 CSA G30.5-M1983 (R1991), Welded Steel Wire Fabric for Concrete Reinforcement.
- .5 CSA G30.18-92, Billet-Steel Bars for Concrete Reinforcement.
- .6 Ontario Electrical Safety Code, Latest Edition.

.2 American Society for Testing and Materials (ASTM)

- .1 ASTM D 1056-91, Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.shop drawings

1.3 Shop drawing

.1 Drawings to include details and/or listing of duct bank components.

PART 2 PRODUCTS

2.1 PVC Ducts

.1 PVC ducts, type DB2

.2 101 mm (4”) nominal diameter.

2.2 PVC Duct fittings

.1 Rigid PVC opaque solvent welded type fittings:

- .1 Bell end fittings,
- .2 Plugs,
- .3 Caps,
- .4 Conduit adaptors,
- .5 Couplings,
- .6 5E angle couplings,
- .7 Large radius elbows, 22.5E, 45E and 90E

.2 Expansion Joints

2.3 Duct Spacers

.1 High density polyethylene.

.2 Interlocking both vertically and horizontally.

.3 Provide stable support from the trench base.

.4 Size and space as per drawings.

.5 To fit between rows of ducts.

2.4 concrete and reinforcing

.1 Cement: CAN/CSA A3000 type 10

.2 Reinforcing bars: CAN/CSA-G30.18, Grade 400

.3 Slump: Table 6 of CAN/CSA-A23.1.

.4 Coarse Aggregate Nominal Size: Clause 14 of CAN/CSA-A23.1

.5 Admixtures: Clause 6 of CAN/CSA-A23.1

.6 Air Content: Table 10 of CAN/CSA A23.1

.7 Protect and cure in accordance with CAN/CSA-A23.1

.8 Minimum 28 day concrete compressive strengths and exposure classifications: 32MPa; C-2.

2.5 Cable pulling equipment

.1 Pull Rope:

.1 Minimum tensile strength of 5kN

.2 Minimum 6mm (1/4”) stranded polypropylene or nylon

.3 Minimum 3m (10’) spare rope at each end

2.6 market tape

.1 Red market tape with black letters identifying the underground duct bank installation.

2.7 Precast concrete maintenance chambers

.1 Aggregates: CSA-A23.1

.2 Cement: CAN/CSA-A5, Type 30

.3 Steel welded wire fabric mesh reinforcing: CSA G30.3

.4 Shall be fabricated in steel forms

.5 Bolts for racks and pulling inserts integrally case in concrete.

.6 Neoprene gasket seals between maintenance chamber sections: ASTM D 1056

.7 Complete with a well in the bottom of the maintenance chamber with a breakout section in the bottom for natural drainage.

.8 Complete with concrete knockout duct sections in each wall of the duct bank. Provided minimum 8 duct knockouts on each face of the maintenance chamber.

.9 Provide floor drain fittings consisting of floor drain, back water valve, trap and pipe connection to drainage system.

.10 Provide a sump pit of 300mm x 300mm x 125mm (1’ x 1’ x 5”).

.11 Provide a storm sewer connection

.12 Maintenance chamber neck to be constructed of concrete brick and mortar.

.13 Provide cast iron frames and covers.

.14 Provide bolted on covers for authorized entry only.

PART 3 EXECUTION

3.1 installation general

.1 Install duct bank and maintenance chambers including formwork.

.2 Build duct bank and maintenance chambers on undisturbed soil or on well compacted granular fill not less than 150 mm (6 in.) thick, compacted to 95% of maximum proctor dry density.

.3 Open trench completely between connected maintenance chambers before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

.4 Bottom of concrete to be below frost line.

.5 Install ducts in accordance with manufacturer’s recommendations & OESC requirement.

.6 Clean ducts before installation.

.7 Install reinforcing in the concrete between ducts in the concrete below the first row of ducts.

.8 Duct to be installed with:

.1 A slope of not less than 1 in 400,

.2 Slope away from the building,

.3 Spacers supporting rows,

.4 Watertight solvent welded joints,

.5 Conduit to duct adapters,

.9 For future extension, terminate duct run with duct coupling set flush with the end of concrete envelope. Ducts to be protected against entrance of water or other matter with adequate and complete caping.

.10 Provide anchors, trench jacks, ties and reinforcing as required to prevent moving during placing of concrete.

.11 Encased duct bank with 75mm (3”) thick concrete envelope.

.12 Remove wood braces and weights before concrete has set and fill voids.

.13 After placing concrete, clean the ducts with steel mandrel and stiff bristly brush to remove all the debris.

.14 Concrete to attain 50% strength before backfilling

.15 Install pull rope in each duct.

.16 Cap ducts watertight.

.17 Install red warning tape across the entire width of the duct bank in the soil half way between the duct bank and grade.

3.2 maintenance chambers

.1 Install precast maintenance chambers.

.2 Provide 115 mm (4½ in.) deep window to facilitate cable bends in wall at each duct connection. Terminate ducts in bell-end fitting flush with window face. Provide four 10 mm (3/8 in.) steel dowels at each duct run connection to anchor duct run

.3 Build up concrete maintenance chamber neck to bring cover flush with finished grade in paved areas and 40 mm (1½ in.) above grade in unpaved areas.

.4 Install maintenance chamber frames and covers for each chamber. Set frames in concrete grout onto chamber neck.

.5 Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated.

.6 Provide two levels of cable racks around the entire perimeter of each maintenance chamber. Provide anchor bolts and pulling irons on all four sides of the maintenance chamber.

.7 Grout frames of maintenance chambers. Cement grout to consist of two parts sand and one-part cement and sufficient water to form a plastic like slurry.

.8 Ensure filling of voids in joint being sealed. Plaster with cement grout the walls, ceiling and neck.

.9 Spray paint an "X" on ceiling of maintenance chamber above floor drain or sump pit.

END OF SECTION

PART 1 GENERAL

1.1 scope

.1 The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.

.2 The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in CSA Z462 – Workplace Electrical Safety.

.3 The scope of the studies shall include all distribution and equipment.

1.2 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

.2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.

.3 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

.4 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

.2 CSA Group (CSA)

.1 CSA Z462-15 – Workplace Electrical Safety.

.3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.

.2 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.

.3 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

.4 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.

.5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

.6 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

.4 The National Fire Protection Association (NFPA)

.1 NFPA 70 - National Electrical Code.

.2 NFPA 70E – Standard for Electrical Safety in the Workplace.

1.3 SUBMITTALS FOR REVIEW/APPROVAL

.1 The short-circuit and protective device coordination studies shall be submitted to the Owner prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing and/or project schedule, approval from the Owner may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

.1 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report.

.2 The report shall include the following sections:

.1 One-line diagram showing protective device ampere ratings and associated designations, cable size and lengths, transformer kVA and voltage ratings, motor and generator kVA ratings, and switchgear/switchboard/panelboard designations.

.2 Descriptions, purpose, basis and scope of the study.

.3 Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.

.4 Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.

.5 Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.

.6 Incident energy and flash protection boundary calculations.

.7 Comments and recommendations for system improvements, where needed.

.8 Executive Summary including source of information and assumptions made.

1.5 QUALIFICATIONS

.1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

.2 The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm and be registered to practice in the Province of Newfoundland and Labrador.

.3 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

.4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed.

1 Products

1.6 STUDIES

.1 Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm. The coordination new and/or modified study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker in the 208 Volt panelboards. Study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency standby generator and distribution switchgear.

.2 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462.

1.7 DATA COLLECTION

.1 Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

.2 Source combination may include present and future utility supplies, motors, and generators.

.3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

1.8 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

.1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141, latest edition.

.2 Transformer design impedances and standard X/R ratios shall be used when test impedances are not available.

.3 Provide the following:

.1 Calculation methods and assumptions.

.2 Selected base per unit quantities.

.3 One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.

.4 Source impedance data, including electric utility system and motor fault, contribution characteristics.

.5 Tabulations of calculated quantities.

.6 Results, conclusions, and recommendations.

.4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

.1 Electric utility's supply termination point.

.2 Incoming switchgear.

.3 Unit substation primary and secondary terminals.

.4 Low voltage switchgear.

.5 Standby generators and automatic transfer switches.

.6 Branch circuit panelboards.

.7 Other significant locations throughout the system.

.5 For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

.6 Protective Device Evaluation:

.1 Evaluate equipment and protective devices and compare to short circuit ratings.

.2 Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses.

.3 Adequacy of transformer windings to withstand short-circuit stresses.

.4 Cable and busway sizes for ability to withstand short-circuit heating.

1.9 PROTECTIVE DEVICE COORDINATION STUDY

.1 Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

.2 Include on each curve sheet, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

.3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

.4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

.5 Electric utility's overcurrent protective device.

.6 Medium voltage equipment overcurrent relays.

.7 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

.8 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.

.9 Transformer full-load current, magnetizing inrush current, and ANSI through- fault protection curves.

.10 Conductor damage curves.

.11 Ground fault protective devices, as applicable.

.12 Pertinent motor starting characteristics and motor damage points, where applicable.

.13 Pertinent generator short-circuit decrement curve and generator damage point.

.14 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

1.10 ARC FLASH HAZARD ANALYSIS

.1 The arc flash hazard analysis shall be performed according to CSA Z462.

.2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards, busway and splitters) where work could be performed on energized parts.

.3 The Arc-Flash Hazard Analysis shall include all new and/or modified equipment where work could be performed on energized parts.

.4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

.5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

.6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.

.7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

.1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.

.2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

.8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy

and flash protection boundary shall include both the line and load side of the main breaker.

.9 Where performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

.10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

.11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.

1.11 REPORT SECTIONS

.1 Input data shall include but not be limited to the following:

.1 Utility 3-phase and L-G available contribution with associated X/R ratios.

.2 Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).

.3 Transformer input data, including winding connections, secondary neutral- ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.

.4 Reactor data, including voltage rating, and impedance.

.5 Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X”d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.

.6 Motor contribution data (induction motors and synchronous motors), including shortcircuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

.2 Short-Circuit Output Data shall include, but not be limited to the following reports:

.1 Low voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each application location:

.1 Voltage

.2 Calculated fault current magnitude and angle

.3 Fault point X/R ratio

.4 Equivalent impedance

.2 Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

.1 Voltage

.2 Calculated symmetrical fault current magnitude and angle

.3 Fault point X/R ratio

.4 Calculated asymmetrical fault currents

.1 Based on fault point X/R ratio
.2 Based on calculated symmetrical value multiplied by 1.6
.3 Based on calculated symmetrical value multiplied by 2.7
.5 Equivalent impedance.

.3 Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
.1 Voltage.
.2 Calculated symmetrical fault current magnitude and angle.
.3 Fault point X/R ratio.
.4 No AC Decrement (NACD) Ratio.
.5 Equivalent impedance.
.6 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
.7 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.

.3 Recommended Protective Device Settings:
.1 Phase and Ground Relays:
.1 Current transformer ratio.
.2 Current setting.
.3 Time setting.
.4 Instantaneous setting.
.5 Recommendations on improved relaying systems, if applicable.
.2 Circuit Breakers:
.1 Adjustable pickups and time delays (long time, short time, ground)
.2 Adjustable time-current characteristic.
.3 Adjustable instantaneous pickup.
.4 Recommendations on improved trip systems, if applicable.

.4 Incident energy and flash protection boundary calculations:
.1 Arcing fault magnitude.
.2 Protective device clearing time.
.3 Duration of arc.
.4 Arc flash boundary.
.5 Working distance.
.6 Incident energy.
.7 Hazard Risk Category.
.8 Recommendations for arc flash energy reduction.

2 Execution

1.12 FIELD ADJUSTMENT

.1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Owner in writing of any required major equipment modifications.

1.13 ARC FLASH WARNING LABELS

.1 The contractor of the Arc Flash Hazard Analysis shall provide a 90 mm x 617 mm thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall have an orange header with the working: “WARNING: ARC FLASH HAZARD” and shall include the following information, at a minimum:

.1 Location designation

.2 Nominal voltage

.3 Flash protection boundary

.4 Hazard risk category

.5 Incident energy

.6 Working distance

.7 Engineering report number, revision number and issue date.

.4 Labels shall be machine printed, with no field markings.

.5 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

.1 For each 600 and 208 volt panelboard, one arc flash label shall be provided.

.2 For each motor control center, one arc flash label shall be provided.

.3 For each low voltage switchboard, one arc flash label shall be provided.

.4 For each switchgear, one flash label shall be provided.

END OF SECTION

PART 1 General

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results for Electrical.

PART 2 Products

2.1 Materials

.1 All services and materials used for the cutting and patching shall meet all requirements specified in Div. 01, and Section 26 05 00, and shall be carried out by experienced workers.

.2 Include for all cutting and patching for all Electrical services.

PART 3 Execution

3.1 Installation

.1 Cut all openings no larger than is required for the services. Core drill for individual services.

.2 Obtain approval from the structural Engineer's Representative before cutting or core drilling any openings or-holes in slabs or structural elements.

.3 Locate all openings in structure elements requiring cutting and patching, and x-ray the structure to obtain Structural Engineer's Representative's approval prior to cutting or core drilling of existing structure. Make adjustments to location of openings as required to minimize cutting of rebar, and completely avoiding electrical conduit.

.1 Cut-holes through slabs only.

.2 Do not cut-holes through beams.

.3 Holes to be cut are 200 mm (Diameter) or smaller only.

.4 Maintain at least 100 mm clear from all beam faces. Space at least 3-hole diameters on Centre.

.5 For-holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.

.6 For-holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.

.4 X-ray scanning: Source of information; concretexray.ca, and A&A concrete x-ray and coring

.1 X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity. The company shall be licensed by the Canadian Nuclear Safety Commission

(CNSC), and all radiography work shall be performed in accordance with the Nuclear Safety and Control Act.

.2 Follow any safety requirements stipulated by the property manager.

.3 Minimum requirements: All people must be evacuated within a radius of 10 m from each exposure location. Prior to conducting exposures verify this “safe zone”. If the 10 m radius includes public areas such as a sidewalk, lobby, or elevator, these areas must be controlled (e.g. elevators shut down or prevented from stopping on floors at which exposures are taking place). In addition, if exposure locations are near the walls of adjacent tenants, ensure the notification and evacuation of people within the 10 m radius. The 10 m radius applies to the camera floor and the floor directly below only. The qualified technician shall ensure adequate precautions for the additional floors above and below the camera floor.

.5 Patch all openings after services have been installed to match the surrounding finishes.

.6 In existing areas all cutting, and core drilling for individual services except where specifically noted, is part of this division work.

.7 The cost of x-ray scanning, cutting, patching and finishing is included in this division contract.

END OF SECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.

.2 The OPR and BOD documentation are included by reference for information only.

.3 Division 01 section 'LEED Requirements' for additional LEED requirements.

1.2 SUMMARY

.1 This section includes commissioning process requirements for Electrical systems, assemblies, and equipment.

.2 Related Sections: ***Edit As Required.***

.1 Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.3 DESCRIPTION

.1 Refer to Division 01 Section "General Commissioning Requirements" for the description of commissioning.

1.4 DEFINITIONS

.1 Refer to Division 01 Section "General Commissioning Requirements" for definitions.

1.5 SUBMITTALS

.1 Refer to Division 01 Section "General Commissioning Requirements" for CxA's role.

.2 Refer to Division 01 Section "Submittals" for specific requirements. In addition, provide the following:

.3 In addition, provide the following:

.1 Certificates of readiness

.2 Certificates of completion of installation, prestart, and startup activities.

.3 O&M manuals

.4 Test reports

1.6 QUALITY ASSURANCE

.1 Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped

or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

.1 Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to coordination during the commissioning process.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

.1 All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the electrical contractor of Division 26 shall ultimately be responsible for all standard testing equipment for the electrical systems and controls systems in Division 26. A sufficient quantity of two-way radios shall be provided by each contractor.

.2 Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.

.3 Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

.4 Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.

.5 All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

.1 With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems

.2 **Red-lined Drawings:**

.1 The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.

.2 Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.

.3 Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.

.4 The contracted party, as defined in the Contract Documents will create the as-built drawings.

.3 **Operation and Maintenance Data:**

.1 Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.

.2 The CxA will review the O&M literature once for conformance to project requirements.

.3 The CxA will receive a copy of the final approved O&M literature once corrections have been mad by the Contractor.

.4 **Demonstration and Training:**

.1 Contractor will provide demonstration and training as required by the specifications.

.2 A complete training plan and schedule must be submitted by the Contractor to the CxA four weeks (4) prior to any training.

.3 A training agenda for each training session must be submitted to the CxA one (1) week prior the training session.

.4 The CA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CA and Owner's representative. A copy of the test record shall be provided to the CA, Owner, and Architect.

.5 Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.

.6 Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.

.7 Review data in O&M Manuals.

.5 **Systems manual requirements:** ***Remove if Systems manual is not required.***

.1 The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.

.2 The GC shall include final approved versions of the following information for the Systems Manual:

.1 As-Built System Schematics

.2 Verified Record Drawings

.3 Test Results (not otherwise included in Cx Record)

.4 Periodic Maintenance Information for computer maintenance management system

.5 Recommendations for recalibration frequency of sensors and actuators

.6 A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information

.7 Training Records, Information on training provided, attendees list, and any on-going training

.3 This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.

.4 Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CONTRACTOR'S RESPONSIBILITIES

.1 Perform commissioning tests at the direction of the CxA.

.2 Attend construction phase controls coordination meetings.

.3 Participate in Electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

.4 Provide information requested by the CxA for final commissioning documentation.

.5 Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.

.6 Prepare preliminary schedule for Electrical system orientations and inspections, operation and maintenance manual submissions, training sessions, equipment start-up and task completion for owner. Distribute preliminary schedule to commissioning team members.

.7 Update schedule as required throughout the construction period.

.8 During the startup and initial checkout process, execute the related portions of the prefunctional checklists for all commissioned equipment.

.9 Assist the CxA in all verification and functional performance tests.

.10 Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

.11 Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.

.12 Coordinate with the CxA to provide 48-hour advance notice so that the witnessing of equipment and system start-up and testing can begin.

.13 Notify the CxA a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.

.14 Participate in, and schedule vendors and contractors to participate in the training sessions.

.15 Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

.1 Electrical equipment including switchgear, panel boards, motor control centers, lighting, receptacles, dimmers and all other equipment furnished under this Division.

.2 Emergency generators, ATS switches and emergency power systems.

.3 Fire alarm system

.4 Lightning protection

.5 UPS systems

.6 List other systems

.16 The equipment supplier shall document the performance of his equipment.

.17 Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.

.18 Provide training of the Owner's operating staff using expert qualified personnel, as specified.

.19 Equipment Suppliers

.1 Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.

.2 Assist in equipment testing per agreements with contractors.

.3 Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

.20 Refer to Division 01 Section "General Commissioning Requirements" for additional Contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

.1 Refer to Division 01 Section "General Commissioning Requirements" for Owner's Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

.1 Refer to Division 01 Section "General Commissioning Requirements" for Design Professional's Responsibilities.

3.5 CxA'S RESPONSIBILITIES

.1 Refer to Division 01 Section “General Commissioning Requirements” for CxA’s Responsibilities.

3.6 TESTING PREPARATION

.1 Certify in writing to the CxA that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

.2 Certify in writing to the CxA that Electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

.3 Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.

.4 Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

.5 Inspect and verify the position of each device and interlock identified on checklists.

.6 Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

.7 Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 GENERAL TESTING REQUIREMENTS

.1 Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

.2 Scope of Electrical testing shall include the entire Electrical installation, from the incoming power equipment throughout the distribution system. Testing shall include measuring, but not limited to resistance, voltage, and amperage of system(s) and devices.

.3 Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

.4 The CxA along with the Electrical contractor and other contracted subcontractors, including the fire alarm Subcontractor shall prepare detailed testing plans, procedures, and checklists for Electrical systems, subsystems, and equipment.

.5 Tests will be performed using design conditions whenever possible.

.6 Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions,

calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

.7 The CxA may direct that set points be altered when simulating conditions is not practical.

.8 The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

.9 If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

.10 If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.8 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

.1 **Equipment Testing and Acceptance Procedures:** Testing requirements are specified in individual Division 26 sections. Provide submittals, test data, inspector record, infrared camera and certifications to the CA.

.2 **Electrical Instrumentation and Control System Testing:** Field testing plans and testing requirements are specified in ***Division 26 Sections "Instrumentation and Control" and "Sequence of Operations"*** Assist the CxA with preparation of testing plans.

.3 **Emergency Generator Testing and Acceptance Procedures:** Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

.4 **Fire Detection and Alarm System Testing:** Provide technicians, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

.5 **Electrical Distribution System Testing:** Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested

.6 **Vibration and Sound Tests:** Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

.7 The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components,

systems and sub-systems. The following equipment and systems shall be evaluated:

1. ***Automatic temperature controls integrated with the electrical systems***
2. ***Coordination and functionality with the Building Automation System/Building Management Controls System***
3. ***Access Control***
4. ***Automatic Transfer Switch***
5. ***Battery Monitoring System***
6. ***CCTV***
7. ***Emergency Generator***
8. ***Emergency Power System***
9. ***EPO System***
10. ***Fire Alarm System***
11. ***Grounding System***
12. ***Lighting Controls***
13. ***Lightning Protection System***
14. ***Low Voltage Switchgear***
15. ***Manual Transfer Switch***
16. ***Motor Control Center***
17. ***Panelboard***
18. ***PDU***
19. ***Power Distribution System***
20. ***Power Monitoring/Metering System***
21. ***Security System***
22. ***Static Switch***
23. ***Switchboard***
24. ***Transformer***
25. ***UPS System***
26. ***List Other Systems***

3.9 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

.1 Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.10 APPROVAL

.1 Refer to Division 01 Section “General Commissioning Requirements” for approval procedures.

3.11 DEFERRED TESTING

.1 Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to deferred testing.

3.12 OPERATION AND MAINTENANCE MANUALS

.1 The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.

.2 Refer to Division 01 Section “General Commissioning Requirements” for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

3.13 TRAINING OF OWNER PERSONNEL

.1 Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to training.

.2 **Electrical Contractor.** The electrical contractor shall have the following training responsibilities:

.1 Provide the CA with a training plan two weeks before the planned training.

.2 Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.

.3 Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

.4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.5 The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

.6 The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

.7 Training shall include:

.1 Use the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discuss relevant health and safety issues and concerns.

.4 Discuss warranties and guarantees.

.5 Cover common troubleshooting problems and solutions.

.6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discuss any peculiarities of equipment installation or operation.

.3 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance of all pieces of equipment.

.1 The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.2 Training shall occur after functional testing is complete, unless approved otherwise by the Owner's.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 SYSTEM DESCRIPTION

.1 Low voltage control system designed to provide remote switching of lighting loads by use of:

- .1 Low voltage momentary contact switches
- .2 Low voltage relays.
- .3 Occupancy sensor complete with power pack.
- .4 Room controller.
- .5 Relay panel.
- .6 Manual switch control

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.2 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.

.3 Closeout Submittals:

- .1 Submit maintenance data in accordance with Section 26 05 10

.4 Test reports:

- .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .4 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 Products

2.1 MATERIALS

.1 Control system: by one manufacturer and assembled from compatible components.

2.2 REMOTE CONTROL SWITCHES

.1 Single pole, double throw, momentary contact, heavy duty, rated 3 A, 25 V, centre pivot rocker action with pilot lights where indicated.

2.3 LOW VOLTAGE RELAYS

.1 Electrically operated by momentary impulse, mechanically latched until activated.

.2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.

.3 Operating voltage: 24 V, AC.

.4 Load contacts: 20 A, 120 or 347 V, AC as indicated.

.5 Auxiliary contacts for pilot light.

.6 Coloured pre-stripped leads.

2.4 CONTROL TRANSFORMER

.1 Low voltage power Class 2, input 120 or 347 V, AC, 60 Hz, output 35 VA at 24 V.

2.5 MANUAL CONTROL

.1 Individual remote control switches as indicated.

.2 Eight circuit manual master selector switch mounted in 100 mm square box with:

.1 Master lock-out switch

.2 Individual red jewelled pilot lights.

.3 Nine circuit manual dial-type master selector.

.4 Twelve circuit manual dial-type master selector.

2.6 MOTOR OPERATED MASTER CONTROL

.1 Motor-driven multiple contact momentary switching device.

.2 Radial contact arm to rotate through one revolution in 17 s.

.3 Contact made in succession between 25 points around circle.

.4 One master required for "ON" operation and one for "OFF" operation.

.5 Motor master units connected in cascade to control circuits as indicated.

.6 Interface equipment as required to convert maintained contact signals to momentary contact control pulses.

2.7 ROOM CONTROLLER

.1 Provide shop drawing for following devices, but not limited to, Room controller, relays, sensors, 2 pole analog interface.

.2 Provide wiring schematic and lighting control floor plan diagrammatic layout for review.

2.8 RELAY PANEL

.1 Provide shop drawing for relay panel and associated relays for review. Relay for normal power lighting shall be dimmer able relay, while for emergency relay shall be standard relay.

.2 Relay panel shall meet UL 924 emergency bypass requirement.

.3 Provide wiring schematic and lighting control floor plan diagrammatic layout for review.

PART 3 Execution

3.1 INSTALLATION

.1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated. Include all required conduit, wiring, power pack, relays, etc.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical

.2 Actuate control units in presence of Owner’s Representative to demonstrate lighting circuits are controlled as designated.

.3 Equipment starts up, programming, commissioning shall be conducted by lighting control manufacture technician. All cost shall be included in bid.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Service equipment and installation.

1.2 RELATED SECTIONS

.1 Section 26 05 28 - Grounding - Secondary.

.2 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.3 Section 26 24 17 - Panelboards - Breaker Type.

.4 Section 26 28 16.02 - Moulded Case Circuit Breakers.

.5 Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.

.6 Section 26 28 20 - Ground Fault Circuit Interrupters - Class "A".

PART 2 Products

2.1 EQUIPMENT

.1 Fused disconnect switch: in accordance with Section 26 28 23 - Disconnect Switches - Fused and Non-Fused, rating as indicated.

.2 Enclosed circuit breaker: in accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers, rating as indicated.

.3 Panelboard breaker type: in accordance with Section 26 24 17 Panelboards - Breaker Type.

.4 Cabinet type 'A' for utility revenue metering Junction box Pull box Splitter box: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets, size as indicated.

.5 Ground fault equipment: in accordance with Section 26 28 20 - Ground Fault Circuit Interrupters - Class "A".

PART 3 Execution

3.1 INSTALLATION

.1 Install service equipment.

.2 Connect to incoming service.

.3 Connect to outgoing load circuits.

.4 Install ground fault equipment.

.5 Make grounding connections in accordance with Section 26 05 28 - Grounding – Secondary.

.6 Make provision for power supply authority's metering.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for service entrance board.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)
  .1 CAN/CSA-C22.2 No.31, Switchgear Assemblies.

1.4 SUBMITTALS

.1 Indicate on shop drawings.
  .1 Floor anchoring method and foundation template.
  .2 Dimensioned cable entry and exit locations.
  .3 Dimensioned position and size of bus.
  .4 Overall length, height and depth.
  .5 Dimensioned layout of internal and front panel mounted components.

.2 Include time-current characteristic curves for circuit breakers and fuses.

1.5 QUALITY ASSURANCE

.1 Submit 3 copies of certified test results.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for service entrance board for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Submit 3 copies maintenance data for complete assembly including components.

1.7 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:
  .1 Three (3) fuses for each type above 600A.
  .2 Six (6) fuses for each type up to and including 600A.

PART 2 Products

2.1 SERVICE ENTRANCE BOARD

.1 Service Entrance Board: to CAN/CSA-C22.2 No.31.

.2 Rating: 600 V, 3 phase, 3 wire, 1000 A, short circuit current 35 kA (rms symmetrical) and/or as indicated on electrical drawings. Cubicles: wall-mounted, or free standing, dead front, size as indicated.

.3 Barrier metering section from adjoining sections.

.4 Provision for installation of power supply authority metering in barriered section.

.5 Owners metering with all required CT's and PT's.

.6 Distribution section.

.7 Hinged access panels with captive knurled thumb screws.

.8 Bus bars and main connections: tin plated aluminum.

.9 Bus from load terminals of main breaker or disconnect switch via metering section to main lugs of distribution section.

.10 Bus from load terminals of main breaker or disconnect switch to metering section and from metering section to lugs of distribution section.

.11 Identify phases with colour coding.

2.2 MOULDED CASE CIRCUIT BREAKERS

.1 Refer to Section 26 28 16.02 – Moulded Case Circuit Breakers.

2.3 FUSIBLE DISCONNECTS AND FUSES

.1 Refer to Section 26 28 23 – Disconnect Switches – Fused and Non-fused.

2.4 GROUNDING

.1 Copper ground bus extending full width of cubicles and located at bottom.

.2 Lugs at each end for size 3/0 grounding cable.

2.5 GROUND FAULT UNIT

.1 Refer to Section 26 28 18 – Ground Fault Equipment Protection.

2.6 POWER SUPPLY AUTHORITY METERING

.1 Separate compartment and metal raceway for exclusive use of power supply authority metering.

.2 Provide mounting accessories and wiring for metering as follows and as indicated:

.1 Three (3) potential transformers.

.2 Three (3) current transformers.

.3 Demand meter with kWH register as required.

.3 Coordinate supply and installation of current and potential transformers for utility metering with utility representative. Carry all associated costs.

2.7 OWNERS METERING

.1 Digital unit with capability to display:

.1 Phase currents

.2 Voltage, L-L, L-N for each phase.

.3 System and per-phase power including watts, vars and VA.

.4 System energy including watthours, varhours and VA hours.

.5 System demand including watt demand, VA demand and var demand.

.6 Apparent and displacement power factor.

.7 Frequency.

.8 Recorded minimums and maximums of most parameters.

.2 Other features:

.1 Operator programmed using the face plate keypad or via communications.

.2 Back lit LCD display, 4 line x 20 character.

.3 All monitored parameters are available at the faceplate. True rms metering of distorted currents and voltages up to the 31st harmonic.

.4 CSA listed under CSA C22.2 #1010.1.

.5 KYZ pulse output to transfer demand signal to building energy management system.

.6 Current and potential transformers as required.

.3 Install metering units at “eye level” so that elevating devices are not required to read and use the meter.

2.8 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

.1 Refer to Section 26 24 05 – Service Entrance TVSS Protection

2.9 LIGHTNING ARRESTERS

.1 Refer to Section 26 41 00.02 – Secondary Lightning Arresters.

2.10 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 – Common Work Results - Electrical.

.1 Service entrance board exterior: gray.

2.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Nameplates:

.1 White plate, black letters, size 7.

.2 Complete board labelled: 120/208 or 347/600 V, 3 phase, 4 wire Amps as indicated.

.3 Main disconnect labelled: "Main Breaker or Switch".

.4 Branch disconnects labelled: as indicated.

PART 3 Execution

3.1 INSTALLATION

.1 Locate service entrance board and fasten to wall or floor as indicated.

.2 Coordinate the supply and installation of current and potential transformers for utility metering with utility representative.

.3 Connect main secondary service to line terminals of main breaker or disconnect switch.

.4 Connect load terminals of distribution breaker's or switches to feeders.

.5 Run one grounding conductor 3/0 AWG bare copper in 25 mm conduit from ground bus to building ground.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance Section 26 05 00 – Common Work Results - Electrical

.2 Check factory made connections for mechanical security and electrical continuity.

.3 Check trip unit settings and fuse sizes against co-ordination study to ensure proper working and protection of components.

.4 Check operation of transient voltage surge suppressor.

.5 Check operation of Owner’s metering.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29, Panelboards and enclosed Panelboards.

1.4 SHOP DRAWINGS

.1 Shop drawings and product data to be submitted in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

PART 2 Products

2.1 PANELBOARDS

.1 Panelboards: product of one manufacturer.

.1 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 Fault current rating shall be per short circuit study where applicable.

.2 120/208V panelboards: bus and breakers rated for minimum 10kA (symmetrical) interrupting capacity or per short circuit study requirement as per contract.

.3 347/600V panelboards: bus and breakers rated for minimum 22kA (symmetrical) interrupting capacity or per short circuit study requirement as per contract.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating as mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked grey enamel

.11 Enclosure to be CSA NEMA 2 Sprinkler Proof.

2.2 BREAKERS

.1 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.2 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.3 Lock-on devices for 10% of 15 to 30A breakers installed as indicated. Turn over unused lock-on devices to owner.

.4 Lock-on devices for fire alarm emergency, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results – Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

PART 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards in accordance with Section 26 05 01 - Common Work Results – Electrical.

.3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results – Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA-C22.2 No.55, Special Use Switches.
- .4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

PART 2 Products

2.1 SWITCHES

.1 15 A, 120 V, single pole, double pole, three-way, four-way switches as indicated to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:

- .1 Terminal holes approved for No. 10 AWG wire.
- .2 Silver alloy contacts.
- .3 Urea or melamine moulding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 White toggle.
- .6 Specification grade.
- .7 Hospital grade as indicated.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

- .1 Ivory thermoplastic moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and rivetted grounding contacts.

.6 Specification grade.

.7 Hospital grade as indicated.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Ivory thermoplastic moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

.1 Special wiring devices:

.1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.

.2 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel lens, flush type.

2.4 WIRING DEVICES FOR COMPUTER ROOMS

.1 As indicated.

2.5 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Nylon ivory or stainless steel cover plates as indicated, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

.5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.8 All wiring device cover plates to be labeled using clear adhesive strips with black type identifying panel and circuit number for each device.

PART 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 – Common Work Results - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 General

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results for Electrical.

1.2 References

.1 CSA C22.2 No. 248, Low Voltage Fuses, latest edition.

1.3 Shop Drawings And Product Data

.1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Submit fuse performance data characteristics for each fuse type and size above 100 A. Performance data to include: average melting time-current characteristics, I2t (for fuse coordination), and peak let-through current.

1.4 Maintenance Materials

.1 Three spare fuses of each type and size installed 600 A. and above.

.2 Six spare fuses of each type and size installed up to and including 400 A.

1.5 Delivery And Storage

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in moisture free location.

2 Products

2.1 Fuses General

.1 Fuses: product of one manufacturer.

.2 Fuses to have an indicating window to identify when the fuse has been blown.

2.2 Fuse Types

.1 Class L fuses.

.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type L2, fast acting.

.2 Class J fuses.

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type J2, fast acting.

.3 Class R fuses. For UL Class RK1 fuses, peak let-through current and I2t values not to exceed limits of CSA C22.2 No. 248.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

.4 Class C fuses.

.5 Fuses for Motors:

.1 All fuses for motor loads are to be time-delay type.

2.3 Fuse Storage Cabinet

.1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door, B-LINE model 243012 + 2 shelves FCS2412, finished in accordance with Section 26 05 00 – Common Work Results for Electrical.

2.4 Fuse Puller

.1 Provide a fuse puller for each size of fuse to be located in the fuse storage cabinet. Fuse puller to be clearly labelled for the appropriate building and fuse cabinet. Fuse puller to be equal to the Ideal Safe-T-Grip Fuse Puller.

2.5 Manufacturers

.1 The following are acceptable manufacturers:

.1 Mersen

.2 Cooper-Bussman

.3 Littelfuse

3 Execution

3.1 Installation

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically match mounting devices.

.1 Install Class R rejection clips for Class R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 26 23 00 - Low Voltage Switchgear.

.2 Section 26 24 02 - Service Entrance Board.

.3 Section 26 28 18 - Ground Fault Equipment Protection.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5 - Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker, latest edition.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 26 05 00 – Common work Results - Electrical.

.2 Include time-current characteristic curves for breakers with ampacity of 400 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

PART 2 Products

2.1 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.2 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from [3-8] times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS

.1 Thermal magnetic breakers with current limiters.

.1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.

.2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

.1 Breakers applied following manufacturer's guidelines and accepted best practice.

2.5 SOLID STATE TRIP BREAKERS

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and [long time] [short time] [instantaneous] tripping for [phase] [ground] fault short circuit protection.

2.6 OPTIONAL FEATURES

.1 Include:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Motor-operated mechanism c/w time delay unit.

.4 Under-voltage release.

.5 On-off locking device.

.6 Handle mechanism.

PART 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Equipment and installation for ground fault circuit interrupters (GFCI).

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.3 PAYMENT PROCEDURES

.1 Pay for field testing of ground fault equipment performed by equipment manufacturer in accordance with Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

1.4 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-C22.2 No.144, Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.5 SUBMITTALS

.1 Submit product data and shop drawings.

.2 Submit test report for field testing of ground fault equipment to Owner's Representative and a certificate that system as installed meets criteria specified herein.

PART 2 Products

2.1 MATERIALS

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single or two pole ground fault circuit interrupter for 15-20 A, 120 V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT LIFE PROTECTOR

.1 A, 2 pole circuit breaker to supply power to mains of 100A, 208 V, 3 phase panel and complete with:

- .1 Automatic shunt trip breaker.
- .2 Zero sequence current sensor.
- .3 Facilities for testing and reset.
- .4 CSA Enclosure 1, surface mounted.
- .5 Ground fault trip indicator light.

2.4 GROUND FAULT PROTECTOR UNIT

.1 Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:

- .1 Solid state ground sensing device.
- .2 Facility for testing and reset.
- .3 CSA Enclosure 1, flush mounted with stainless steel face plate.

2.5 SYSTEM GROUND FAULT PROTECTION PANEL

.1 Self-contained panel suitable for120/208 V, 3 phase, 4 wire, grounded supply. Panel to have following features:

- .1 Automatic 100 or 225 A breaker with shunt trip.
- .2 Ground fault relay factory set at 10 mA with inverse time delay characteristics from pick-up 1 s to 0.025 s.
- .3 Zero sequence current sensor.
- .4 Provision for testing and reset.
- .5 CSA Enclosure 1, surface mounted.
- .6 Ground fault trip indicating light.
- .7 Resistor type fused artificial neutral.

2.6 PUMP PROTECTION PANEL

.1 Ground fault personnel protection panel for pump circuits rated for 20 hp at 208 V and 50 hp at 600 V, 3 phase grounded supply with following features:

- .1 Test button, ground indicator light, reset button.
- .2 Line and load terminal blocks and control terminal block for wiring to starter control.
- .3 Unit sensitivity: 10 mA.
- .4 CSA Enclosure 1, surface mounted.
- .5 Contact rating: 5 A, 120 V, 60 Hz.
- .6 Fused resistive type artificial neutral.

PART 3 Execution

3.1 INSTALLATION

.1 Do not ground neutral on load side of ground fault relay.

.2 Pass phase conductors including neutral through zero sequence transformers.

.3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 Arrange and pay for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.

.3 Demonstrate simulated ground fault tests.

END OF SECTION

PART 1 General

1.1 RELATED Sections

.1 Section 26 05 00 – Common Work Results - Electrical.

PART 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible, disconnect switch in CSA Enclosure type 1, size as indicated.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, to Section 26 28 13.01 - Fuses - Low Voltage.

.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses as indicated.

END OF SECTION

PART 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

.2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 United States of America, Federal Communications Commission (FCC)

.1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.3 SUBMITTALS

.1 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Owner’s Representative.

.2 Photometric data to include: VCP Table and spacing criterion and luminaire coefficient of utilization (CU) tables.

.3 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Quality assurance submittals: provide the following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and re-lamping schedule.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Divert unused metal materials from landfill to metal recycling facility.

.4 Disposal and recycling of fluorescent lamps as per local regulations.

.5 Disposal of old PCB filled ballasts.

1.5 ACCEPTABLE PRODUCTS

.1 Luminaires described in the Lighting Fixture Schedule identify quality, performance criteria and other parameters, as indicated for this project. Named fixtures are acceptable with modifications and accessories, as indicated.

.2 Fixtures from other manufacturers may be acceptable provided:

.1 Appearance and lighting performance are similar.

.2 Quality is equal or better.

.3 Lamp and ballast criteria remain the same.

.4 Photometric calculation is provided 5 days prior to tender closing date for consultant review and approval.

PART 2 Products

2.1 LAMPS

.1 Incandescent lamps to be - clear, A19, 100 Watt with 1000 hour lamp life, rough-service rated; or as indicated.

.2 Tungsten halogen lamps to be - clear, T-3, 300 Watt, RSC base, 2000 hour lamp life, 5000 lumens; or as indicated.

.3 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid or instant start to suit application, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.

.4 Metal halide lamps to be - clear, BT37, 400 Watt, mogul base, horizontal burn, 4100 K, 15,000 hour lamp life, 36,000 initial lumens, CRI65, open or enclosed type to suit the luminaire; or as indicated.

.5 Low pressure sodium lamps to be - clear, T21, 135 Watt, BY22d base, horizontal burn,16,000 hour lamp life, 22,000 initial lumens; or as indicated.

.6 High pressure sodium lamps to be - clear, ED18, 400 Watt, mogul base, 30,000 hour lamp life, 54,000 initial lumens; or as indicated.

.7 Compact fluorescent lamps to be - 18 Watt, G24q-2 base, 12,000 hour lamp life, 12,000 initial lumens, 4100 K, CRI 80; or as indicated.

2.2 BALLASTS

.1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.

.1 Rating: 120 or 347 V, 60 Hz, as indicated, for use with 2-32W, T8 Octron imperial lamps.

.2 RFI/EMI suppression circuit to: FCC (CFR47) Part 18, sub-part C, Class A and Part 15, sub-part B, Class B.

.3 Totally encased and designed for 40 °C ambient temperature.

.4 Power factor: minimum 98 % with 98% of rated lamp lumens.

.5 Crest factor: 1.5 maximum.

.6 Capacitor: thermally protected.

.7 Thermal protection: non-resettable on coil.

.8 Harmonics: 10 % maximum THD.

.9 Operating frequency of electronic ballast: 20 khz minimum.

.10 Total Circuit Power: 62 Watts.

.11 Ballast Factor: greater than 0.90.

.12 Sound rated: Class A.

.13 Mounting: integral with luminaire.

.14 Be warranted by manufacturer for five years.

.2 Metal halide ballast: design B.

.1 Rating: 60 Hz voltage as indicated, for use with metal halide lamp as indicated. Provide circuitry for standby light to provide light for starting and restart.

.2 Totally encased and designed for 40 °C ambient temperature.

.3 Power factor: minimum 95 % with 95% of rated lamp lumens.

.4 Type: constant wattage auto-transformer or solid state.

.5 Input voltage range: plus or minus 10% of nominal.

.6 Minimum starting temperature: minus 29 °C at 90% line voltage.

.7 Mounting: outdoor integral with luminaire.

.8 Current crest factor: 1.7 maximum current.

.3 High pressure sodium ballast: to ANSI C82.4 design C.

.1 Rating: 60Hz voltage as indicated, for use with high pressure sodium lamps, as indicated.

.2 Totally encased and designed for 40 °C ambient temperature.

.3 Power factor: minimum 95 % with 95% of rated lamp lumens.

.4 Type: reactor or solid state with matching igniter as recommended by manufacturer.

.5 Input voltage range: plus 10% to minus 10% of nominal.

.6 Minimum starting temperature: minus 34 °C at 90% line voltage.

.7 Mounting: outdoor integral with luminaire.

.8 Current crest factor: 1.7 maximum current.

.4 Low pressure sodium ballast: design D.

.1 Rating: 60 Hz voltage as indicated, for use with low pressure sodium lamps as indicated.

.2 Totally encased and designed for 40 °C ambient temperature.

.3 Power factor: minimum 95% with 95% of rated lamp lumens.

.4 Type: constant wattage.

.5 Input voltage range: plus or minus 20% of nominal.

.6 Minimum starting temperature: minus 34 °C at 90% line voltage.

.7 Mounting: outdoor integral with luminaire.

2.3 DRIVERS

.1 All drivers are to be tested and comply with maximum in-rush current limits within NEMA 410 standards. This is to be clearly indicated on shop drawing submittal.

.2 LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.

.3 Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

.4 Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.

.5 No visible change in light output with a variation of plus/minus 10 percent line voltage input.

.6 Total Harmonic Distortion less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

.7 Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:

.1 Adjustment of forward LED voltage, supporting 3V through 55V.

.2 Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA

.3 Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.

.8 Driver must be able to operate for a (+/- 10%) supply voltage of 120V through 277VAC at 60Hz.

.9 Driver must be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.

.10 Driver shall include ability to provide no light output when the analog control signal drops below 0.5 V, or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.

.11 Over the entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0% relative light output, or 100 – 1% light output and step to 0% where indicated. Driver shall respond similarly when raising from 0% to 100%

.1 Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.

.12 Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels

.13 Drivers to track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.

.14 Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:

.1 LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.

.2 Base specification: Flicker index shall less than 5% at all frequencies below 1000 Hz.

.3 Preferred specification: Flicker index shall be equal to incandescent, less than 1% at all frequencies below 1000 Hz.

.15 Control Input

.1 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers

.1 Must meet IEC 60929 Annex E for General White Lighting LED drivers

.2 Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.

.16 Must meet ESTA E1.3 for RGBW LED drivers

2.4 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.5 LUMINAIRES

.1 As indicated in luminaire schedule on drawings. Provide 10% spare lamps of each type noted in luminaire schedule.

2.6 OPTICAL CONTROL DEVICES

.1 As indicated in luminaire schedule on drawings.

PART 3 Execution

3.1 INSTALLATION

.1 The contractor will provide, receive, unload, uncrate, store, protect and install lamps, luminaires, and other related lighting equipment as specified herein. Lamps for all equipment will be provided and installed by the contractor according to equipment manufacturer's instructions.

.2 The Electrical Contractor shall be responsible for the supply and installation of all concrete bases for poles and bollards. Unless otherwise shown on the drawings, concrete bases to be ArtForm style or Approved Equal and shall extend a minimum 900mm above grade in parking lots and a minimum 150mm above grade in pedestrian walkways.

.3 Poles and bollards are to be installed on independent concrete bases unless indicated otherwise on the drawings or schedules. Coordinate brackets for cameras and supports for banners with pole manufacturer.

.4 Install remote ballasts in racks and wire luminaires to ballasts in conduit. Provide wiring as per manufacturer's recommendations.

.5 Locate luminaires in accordance with the Architect's Drawings. Coordinate exact locations on site. Refer to Architect's drawings for dimensions of coves and valences. Fluorescent staggered coves must have a minimum of two inches overlap.

.6 Install in accordance with Manufacturer's Instructions, Local Codes, Electrical Division Drawings and Specifications.

.7 Locate and install luminaires as indicated. Install lamps in all fixtures.

.1 Provide adequate support to suit ceiling system.

3.2 WIRING

.1 Connect luminaires to lighting circuits.

.1 Install flexible conduit for vertical power supply drop to luminaires as indicated. Horizontal wiring using flexible conduit is not permitted.

3.3 LUMINAIRE SUPPORTS

.1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 INSTALLATION OF EXIT SIGNS

.1 Exit sign shall not be installed in line of sight of other services, such as duct work, plumbing pipe or sprinkler pipe. Contractor shall coordinate on site with other trades prior to rough-in. any exit signs installed that do not meet the satisfaction of the Engineer's Representative/Architect, the Contractor shall lower, raise or relocate the exit sign(s) such that proper and adequate visibility of the exit sign(s) is achieved at no additional cost to the Owner.

3.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results

END OF SECTION

PART 1 CODES & STANDARDS

1.1. All work shall be conducted after hours and on weekends. security clearances will be required to work on the premises.

1.2. Complete the installation of the work in accordance with latest editions of ansi/tia/eia, bicsi, the Ontario Building Code, Ontario Electrical Safety Code, c.s.a. standards, u.l.c., n.f.p.a., and other codes, as required. all telecommunications work shall be performed in compliance with base building standards and the facility requirements.

PART 2 INTENT

1.3. It is the intent of these drawings and specifications that the contractor provides complete and operational systems as required.

1.4. Where differences occur, between drawings and specifications, the maximum condition shall govern.

1.5. Any miscellaneous items, hardware, devices, wiring, etc., not specifically described, but required for the operation of the system as described in the drawings or specifications, must be provided and included as part of the bid.

PART 3 DEFINITIONS

1.6. Wherever the words "provide" are used, it shall be understood to mean "device to be provided by electrical engineer. Installation of device to by others" for the item to which it references.

1.7. Wherever the words "supply and install", are used, it shall be understood to mean "provide and install, inclusive of all labour, materials, installation, testing, and connections" for the item to which it references.

PART 4 INSURANCE

4.1. Provide and maintain insurance to protect the landlord, tenant and trades from all possible claims. Submit with bid proof of insurance for an amount acceptable to the landlord and the tenant.

PART 5 EXISTING CONDITIONS

5.1. The drawings are diagrammatic and are to be used to indicate the typical conditions of the site. The existing condition of the site may differ from the conditions depicted on the drawing. It is the responsibility of the contractor to determine the current site conditions and provide for removal and relocation of telecommunications devices to suit the new layout as required.

PART 6 CONTRACT DOCUMENTS

6.1. The drawings for the telecommunications work are diagrammatic performance drawings only, intended to convey the scope of work and indicate the general arrangement and approximate location of telecommunications devices and equipment. The drawings do not intend to show architectural, interior design, mechanical, structural or base building details. Be responsible for a thorough knowledge of same before proceeding with the work.

6.2. Do not scale or measure drawings. Obtain information regarding accurate dimensions from designer/architect's drawings.

6.3. Report any discrepancies between drawings and/or specifications and existing conditions or designer's drawings prior to installation.

6.4. Cooperate and coordinate with other trades in laying out of work so as not to conflict with the work of other trades. Carry out work promptly as per construction schedule and coordinate with work of other trades.

6.5. Make, at no additional cost, any changes or additions to materials and equipment necessary to accommodate structural conditions (offsets around beams, column, etc.)

PART 7 SHOP DRAWINGS

7.1. Submit four (4) copies of shop drawings of all specified equipment for review and records before commencement of work.

7.2. Each shop drawing shall be checked and stamped by electrical and general contractor prior to submission to the engineer for review.

PART 8 IDENTIFICATION

8.1. All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in ul 969 (ref. D-16). In addition, the labels shall meet the general exposure requirements in ul 969 for indoor use.

8.2. Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times. All labels must be machine printed using a laser/inkjet printer. Hand-written labels are not permitted.

8.3. The cabling contractor shall supply and install 15 additional labels (per floor) of ½ inch lettering height (up to 25 letters each label) for use on cabinets, racks, patch panels or active equipment to be used at the project manager's discretion.

8.4. Labels should be attached to the front of the workstation faceplate, one to the front of the distribution connector/idc field or patch panel, and one at each end of the cable (within 4 inches of end). Cables should also be labelled at the grid point just before the cable coil.

8.5. The cable labelling scheme for all horizontal cables at both ends shall be as follows:

Horizontal cable: d/vax-z, where:

– "d/v" indicates data or voice

– "a" indicates the floor id (2 digits).

– "x" indicates the telecommunications room identifier.

– "z" indicates the cable number.

Inter-floor cable (fibre): c-z

– "c" indicates the originating room number.

– "z" indicates the strand number.

PART 9 MATERIALS AND EQUIPMENT

9.1. All materials and equipment shall be new, ul or ul(c) certified and manufactured to the standards specified.

9.2. All materials shall be by a single manufacturer unless otherwise stated. Acceptable manufacturer(s) are as follows:

9.2.1. Panduit: tx-6000 series

9.2.2. Commscope/systimax: gigaspeed xl series

9.2.3. Belden cdt: 2400 series

9.3. The structured cabling system shall meet the minimum performance standards for:

9.3.1. Category 6

9.4. The telecommunications contractor must be certified and warranted by the acceptable manufacturer to install the stated performance system. The contractor must provide proof of certification status with bid submission.

PART 10 LOCATION OF OUTLETS

10.1. Refer to designer/architect's drawings for exact locations of all outlets. For each outlet location shown on the drawing, provide two data cables terminated with jacks and cover plate.

10.2. Alter location of outlets at no cost or credit, providing distance does not exceed 3m (10'-0") and information is given before rough-in.

10.3. All outlets to be marked on job site for approval by consultant prior to installation.

PART 11 PLYWOOD

11.1. Telecommunications backboards (if required) shall be provided by the electrical contractor.

PART 12 CABLE SUPPORT SYSTEMS

12.1. All cable trays, sleeves and conduit shall be provided by the electrical contractor.

12.2. Provide cable support hangers where conduit, cable tray and sleeves have not been installed.

12.3. All cable support hangers shall be panduit j-mod or j-pro product lines. Provide all necessary hardware properly connect support hangers to the building structure.

12.4. Support hangers shall be independently supported. Do not attach support hangers to ceiling support structures, conduit, cable trays, ductwork or mechanical piping systems.

PART 13 HORIZONTAL CABLING SYSTEMS - DATA/VOICE NETWORKS

13.1. Category 6 cable minimum 250 mhz unshielded twisted pair cable with eight (8) - 24 awg thermoplastic insulated, solid conductors formed into individually twisted pairs.

13.2. All copper horizontal cables to be enclosed in a cmp (ft6) thermoplastic jacket.

13.3. Use blue coloured cable sheath for all horizontal data cables and white coloured sheath for all horizontal voice cables.

13.4. At workstation end, terminate cables on an appropriately coloured 8 position modular outlet. At telecommunications room end, terminate cables on existing copper patch panel(s). Provide new patch panels were required to accommodate all terminations.

13.4. Provide voice & data cabling in quantities and locations as indicated on floor plans.

PART 14 HORIZONTAL CABLING SYSTEMS - ACCESS CONTROL AND CCTV

14.1. Category 6 cable minimum 250 mhz unshielded twisted pair cable with eight (8) - 24 awg thermoplastic insulated, solid conductors formed into individually twisted pairs.

14.2. All copper horizontal cables to be enclosed in a cmp (ft6) thermoplastic jacket.

14.3. Use yellow coloured cable sheath for all access control system cables and green coloured sheath for all CCTV camera cables.

14.4. At workstation end, terminate cables on an appropriately coloured 8 position modular outlet. At telecommunications room end, terminate cables on new copper patch panel(s).

14.4. Provide one (1) data cable for each CCTV camera as indicated on floor plans.

PART 15 TERMINATION HARDWARE

15.1. Eight position modular outlet

15.1.1. Performance to comply with ansi/eia/tia-568-b.2-1 100 balanced twisted pair connecting hardware specifications and ansi/eia/tia-568-b.2-1 transmission performance specifications for 4-pair category 6 cabling

15.1.2. Pinout termination sequence = t568a (unless stated otherwise).

15.1.3. Terminate voice cabling with white modular outletand data cabling with a blue modular outlet. Terminate access control cabling with yellow modular outlet and cctv camera cabling in with a green modular outlet.

15.2. Wall faceplates for modular jacks

15.2.1. Decora style single gang straps equipped with three (3) ports, which will accommodate rj45 style, as indicated on the communications floor plans.

15.2.2. Where applicable, use blanks for all unused ports. Blanks to match faceplate.

15.3. Copper patch panel

15.3.1. 48 port high density, 2u category 6 copper patch panel

15.3.2. Color: black

15.4. Category 6 utp patch cords

15.4.1. Category 6 utp patch cords are to be factory assembled by the same manufacture used for the end to end cabling system and not site prepared.

15.4.2. Performance to comply with ansi/eia/tia-568-b.2 section 5 - 100 balanced twisted pair connecting hardware specifications and ansi/eia/tia-568-b.2-1 transmission performance specifications for 4-pair 100 category 6 cabling.

15.4.3. For workstation end, provide one (1) white, 10 foot patch cord for each voice cable installed. Provide one (1) blue 10 foot patch cord for each data cable installed. Refer to floor plans for quantities.

15.4.4. For telecommunications room end, provide one (1) grey, 7 foot patch cord for each voice and data cable installed. Refer to floor plans for quantities.

15.5. Equipment cabinet & accessories

15.5.1. Existing rack shall be reused.

15.6. Horizontal cable managers

- For all cabinets and/or racks containing, horizontal structured cabling, horizontal cable managers (compatible with standard 19" equipment racks) are to be provided. The horizontal cable managers are to be hinged at the front with vertical access to the patch panel above and below. Each horizontal cable manager is to be 2 rack units (2u) in height.

- For each cabinet and/or rack a total of two horizontal cable managers, per patch panel, is to be supplied plus one additional horizontal cable manager.

15.7. Power bars

- Each cabinet and/or rack is to come complete with two vertical power bars mounted to the back of the rack. Each power bar is to have a minimum of 8 outlets. Power bars will be rated at a minimum of 110v, 20a with locking male input plug. The power bars are to have a minimum power cord length of 6 feet.

15.8. Ground all rack, cabinets and mounted accessories to telecom. Ground bus bar (by electrical) as per ansi/tia/eia 607 requirements.

PART 16 TESTING, IDENTIFICATION AND ADMINISTRATION

16.1. Provide materials and labour as specified in this section to complete the work as required by the contract documents.

16.2. Testing for the installed structured cabling system shall meet minimum guidelines set by the manufacturer of the installed cabling system

16.3. All testers must be level iii testers and meet the accuracy requirements as identified in annex b of ansi/eia/tia 568 b.2-1.

16.4. Test results to be provided in soft and hard copy formats. Tester should be a fluke 1200/1600 or equivalent. Use of a tester other than the fluke to be

pre-approved before testing. Tester to have been calibrated within 1 year of the test being performed.

16.5. The test documentation will provide the communication consultant with full cable traces (all test point data) that can be updated and evaluated at a later date.

16.6. Upon completion of the testing by the telecommunications cabling contractor, the communications consultant will ask the telecommunications cabling contractor to perform a random test of up to 10% of the cables.

16.7. The random test shall be performed in the presence of the communication consultant and a representative of the owner.

16.8. All deficiencies must be corrected before communications consultant will provide a certificate to release the holdback on the project.

16.9. Testing of all horizontal copper and other copper cables shall be completed in accordance with the follow test criteria: the permanent link test shall be used to verify the performance of the permanently installed cabling.

16.10. The primary field test parameters shall be: wire map length insertion lossnear-end cross-talk (next) lossequal-level far end cross-talk (elfext)power sum near-end cross-talk losspower sum equal-level far end cross-talk (pselfext) return losspropagation delaydelay skewlcl (longitudinal conversion loss)lctl (longitudinal conversion transfer loss).

16.11. Test each strand of fibre with an optical time domain reflectometer for length and attenuation. Performance test must be below the total return loss budget for the cable connectors. Provide comprehensive optical time domain reflectometry (otdr) testing for fibre runs greater than half a kilometre. Include a hard copy chart recording with the test documentation

16.12. Test each strand of fibre with a power meter / light source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres and 1310 nm and 1550 nm for single mode fibres. Perform these tests in both directions. These tests are to be completed after cable installation, splicing and connectors are installed. Tabulate and include test results with test documentation.

16.13. A test report based on the cable schedules is to be produced. The report should indicate for each cable the values of all measured parameters, when it was tested successfully and the signature of the technician that performed the test, location, cable type, cable number and tester make and model.

16.14. Correct all cable faults. Splicing of any cables will not be permitted, for any reason, unless prior authorization is received in writing from the project manager.

PART 17 WORK IN NEW AND RENOVATED AREAS

17.1 The telecommunications contractor shall be responsible for the complete disconnect and removal all existing telecommunications cabling, devices and equipment as outlined in the contract documents.

17.2 When removing existing telecommunications cabling, each cable shall be fully traced and documented to ensure that any existing cabling systems which are to remain are not damaged or disrupted. Removal includes removal of all wiring from outlet back to the associated termination field.

17.3 Ensure that all existing equipment which is to be reused and/or relocated is thoroughly inspected and refurbished to ensure correct operation when put back into service and to meet Ontario Hydro approval.

17.4 Carry out the work with a minimum of noise, dust and disturbance. Where excessive noise, dust, or distirbunces are required for the completion of work, the work shall be completed at a time that is suitable for the tenants prior to completion of any work. Obtain written approval from landlord before any cutting is carried out.

17.5 Provide tools and clean up equipment. Obtain the landlord's permission for the use of electrical, elevator, plumbing or drainage outlets.

17.5 provide daily clean up and proper disposal of debris generated by daily operations. On completion of the work, all tools, surplus materials and waste materials shall be removed and the premises left in a clean and perfect condition.

PART 18 INTERRUPTION OF SERVICES

18.1 The contractor shall assume full responsibility for any interruptions or disruptions to the existing services. All existing building services outside of the scope of work must be kept operational at all times.

18.2 Interruptions in services shall be performed only after regular office hours. Include in the bid price all cost associated with this work.

18.3 Arrange work such that interruptions in services occur only at scheduled times suitable to the landlord.

18.4 Interruptions in services shall be scheduled at least 48 hours in advance with the landlord.

PART 19 COMPLETION OF CONTRACT

19.1 All the equipment and cabling must be cleaned and tested, before acceptance by the consultant.

19.2 At points of termination, all cabling and terminations must be free of any cable pulling lubricants before acceptance by the telecommunications consultant.

19.3 From the date of issuance of a “certificate of substantial performance”, all equipment, materials and workmanship must be unconditionally warranted for a period of one (1) year, or such longer periods as may be provided in the warranty of the manufacturer of individual components, whichever is longer.

19.4 Provide a formal written certificate and warranty that the communications cabling system is installed and fully certified in accordance with this and the manufacturer's specifications.

END OF SECTION

PART 1 CODES & STANDARDS

1.1. All work shall be conducted after hours and on weekends. Security clearances will be required to work on the premises

1.2. Complete the installation of the work in accordance with latest editions of the Ontario Building Code, Ontario Electrical Safety Code, c.s.a. standards, u.l.c., n.f.p.a., and other codes, as required. All electrical work shall be performed in compliance with base building standards and the facility requirements.

PART 2 INTENT

2.1. It is the intent of these drawings and specifications that the contractor provide complete and operational systems as required.

2.2. Where differences occur, between drawings and specifications, the maximum condition shall govern.

2.3. Any miscellaneous items, hardware, devices, wiring, etc., not specifically described, but required for the operation of the system as described in the drawings or specifications, must be provided and included as part of the bid.

PART 3 DEFINITIONS

3.1. Wherever the words "provide" are used, it shall be understood to mean "device to be provided by electronic safety and security (ess) contractor. Installation of device to by others" for the item to which it references.

3.2. Wherever the words "supply and install", are used, it shall be understood to mean "provide and install, inclusive of all labour, materials, installation, testing, and connections" for the item to which it references.

PART 4 INSURANCE

4.1. Provide and maintain insurance to protect the landlord, tenant and trades from all possible claims. Submit with bid proof of insurance for an amount acceptable to the landlord and the tenant.

PART 5 EXISTING CONDITIONS

5.1. The drawings are diagrammatic and are to be used to indicate the typical conditions of the site. The existing condition of the site may differ from the conditions depicted on the drawing. It is the responsibility of the contractor to determine the current site conditions and provide for removal and relocation of electrical devices to suit the new layout as required.

PART 6 CONTRACT DOCUMENTS

6.1. The drawings for the ess work are diagrammatic performance drawings only, intended to convey the scope of work and indicate the general arrangement and approximate location of access control and cctv equipment. The drawings do not intend to show architectural, interior design, mechanical, structural or base building details. Be responsible for a thorough knowledge of same before proceeding with the work.

6.2. Do not scale or measure drawings. Obtain information regarding accurate dimensions from designer/architect's drawings.

6.3. Report any discrepancies between drawings and/or specifications and existing conditions or designer's drawings prior to installation.

6.4. Cooperate and coordinate with other trades in laying out of work so as not to conflict with the work of other trades. Carry out work promptly as per construction schedule and coordinate with work of other trades.

6.5. Make, at no additional cost, any changes or additions to materials and equipment necessary to accommodate structural conditions (offsets around beams, column, etc.)

PART 7 SHOP DRAWINGS

7.1. Submit four (4) copies of shop drawings of all specified equipment for review and records before commencement of work.

7.2. Each shop drawing shall be checked and stamped by ess and general contractor prior to submission to the engineer for review.

PART 8 IDENTIFICATIONS

8.1. Provide lamacoid nameplates on all panels, disconnect switches, splitters, etc., to match base building. Nameplates shall identify equipment name, voltage, phase, current rating, and use. Nameplates shall be white, with 1/4" black letters,mechanically attached to equipment.

8.2. Provide typewritten directories for new and existing panels. Confirm existing identification and correct where necessary.

8.3. Clearly mark all exposed conduit, pullboxes, junction boxes, etc., to indicate the nature of the service to match base building standards.

8.4. Provide label for all receptacles to identify the circuit which the receptacle is fed from. Labeling shall be dymo-tape, with 1/8" black letters.

PART 9 MATERIALS AND EQUIPMENT

9.1. All materials and equipment shall be new, c.s.a. certified and manufactured to the standards specified.

9.2. Where there is no alternative to supplying equipment which is not c.s.a. certified, obtain special approval from the local electrical safety authority prior to ordering.

PART 10 LOCATION OF RECEPTACLES

10.1. Refer to designer/architect's drawings for exact locations of all receptacles.

10.2. Alter location of receptacles at no cost or credit, providing distance does not exceed 3m (10'-0") and information is given before rough-in.

10.3. All receptacles to be marked on job site for approval by consultant prior to installation.

PART 11 PLYWOOD

11.1. Fire rated plywood for comms and security (if required) shall be provided by the electrical contractor.

PART 12 INSERTS, HANGERS, AND SLEEVES

12.1. Provide cable support hangers in accessible ceiling(s) where conduit has not been provided.

12.2. Inserts are to be of a lead shield type.

12.3. Hangers must not be welded to structural steel members and burning of holes in structural steel is prohibited.

12.4. Do not use any base building supports or equipment, including ceiling support system.

PART 13 CUTTING AND PATCHING

13.1. All cutting and patching required to the existing building structure for the work shall be included under this contract and be acceptable to the landlord. Obtain written approval from landlord before any cutting is carried out.

13.2. Where conduits pass through fire rated walls or floors, provide c.s.a. approved or u.l.c. listed fire stopping material and maintain same fire rating of building elements.

PART 14 TENANT’S EQUIPMENT

14.1. Where specified, install all equipment provided by the tenant. Receive, store and install equipment and accept full responsibility for its correct operation. Provide conduit, wire, boxes, switches, outlets, devices, flex connections, etc., as required.

14.2. Confirm power requirements of all equipment supplied. Ensure that all electrical equipment supplied by other trades is suitable for the respective voltage.

PART 15 WORK IN NEW AND RENOVATED AREAS

15.1. Be responsible and pay for any damage to the base building incurred by work of this division, or repair to the satisfaction of the consultant.

15.2. Carry out the work with a minimum of noise, dust and disturbance. Where excessive noise, dust, or distirbunces are required for the completion of work, the work shall be completed at a time that is suitable for the tenants prior to completion of any work. Obtain written approval from landlord before any cutting is carried out.

15.3. Provide tools and clean up equipment. Obtain the landlord's permission for the use of electrical, elevator, plumbing or drainage outlets.

15.4. Provide daily clean up and proper disposal of debris generated by daily operations. On completion of the work, all tools, surplus materials and waste materials shall be removed and the premises left in a clean and perfect condition.

PART 16 INTERRUPTION OF SERVICES

16.1. The contractor shall assume full responsibility for any interruptions or disruptions to the existing services. All existing building services outside of the scope of work must be kept operational at all times.

16.2. Interruptions in services shall be performed only after regular office hours. Include in the bid price all cost associated with this work.

16.3. Arrange work such that interruptions in services occur only at scheduled times suitable to the landlord.

16.4. Interruptions in services shall shall be scheduled at least 48 hours in advance with the landlord.

PART 17 VALUATION OF CHANGES

17.1. Provide complete breakdown of material, labour, overhead, profit, etc., when submitting quotations for change notices on this project.

17.2. The hourly labour rate shall be inclusive of all charges for supervision, variable labour factors, hand tools, payroll burdens, height factors, warranties, storage, rentals, additional bonding, parking, clean-up, as-built drawings, hoisting, freight and delivery, but exclusive of overhead and profit.

17.3. The labour hours shall be based on the latest issue of the national electrical contractors association (neca) labour units.

17.4. The material prices shall be based on the current national prices system (nps) catalogue less applicable trade discounts.

PART 18 COMPLETION OF CONTRACT

18.1. All equipment must be cleaned and tested before final acceptance by consultant.

18.2. Prior to contacting the consultant for final inspection, the contractor must correct all deficiencies as specified on the deficiency list.

18.3. After completion of work provide a copy of final hydro inspection certificate. Fire alarm verification certificate (as per standard u.l.c. 537) must be provided when the fire alarm system was modified under the contract.

18.4. Provide a written guarantee for one year covering all equipment, materials and workmanship from the date of acceptance of the installation by the owner. Include in the operations and maintenance manual.

18.5. Where required by municipal authorities having jurisdiction provide emergency lighting level test results. Submit test report to consultant and authorities for review. Where battery unit system is used for emergency lighting the contractor shall provide a written statement from the manufacturer indicating that the system has been installed in accordance with manufacturer recommendations and the readings of the emergency lighting level comply with the ontario building code. Reading report and manufacturer statement as shown above shall occur prior to occupancy.

18.6. Any defects or deficiencies which originate or become evident during the warranty period must be repaired or corrected at no extra cost to the owner.

18.7. Replace, at no cost, all incandescent lamps burned-out during a thirty (30) day period and all burned-out fluorescent and hid lamps for a period of ninety (90) days after date of issuance of certificate of "substantial performance" for the contract for the work.

18.8. If, during the warranty period, transformers, ballasts or other noise and vibration producing equipment are considered by the consultant to exceed acceptable standards, then these must be replaced without delay or additional cost to the owner. All work relating to the replacement of defective items, must be carried out after normal working hours and at a time which is acceptable to the tenant.

PART 19 AS-BUILT DRAWINGS

19.1. At the completion of work and before final acceptance, provide as-built drawings of the installation (hard copies red line format). Consultant will prepare the autocad as-builts as per io standards.

19.2. Incorporate all changes and deviations from tender drawings, utilizing normal recognized drafting procedures that match the original drafting methodology.

19.3. All main branch conduit runs, junction box locations, conduit runs for all floor outlets, etc., must be reflected on the drawings.

19.4. Remove the electrical engineer's stamp and company name from all drawings.

19.5. Clearly indicate the words "as-built" in the title block column of the drawings as well as the electrical contractor's name and address.

19.6. Submit a print to consultant for review. When found acceptable by the consultant, submit three (3) sets of prints together with autocad disks for presentation to landlord and tenant.

PART 20 OPERATION AND MAINTENANCE MANUALS

20.1. Provide 2 (two) sets of operation and maintenance manuals. Include the following information in the operations and maintenance manuals:

20.1.1. Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature is not acceptable.

20.1.2. The consultants reviewed shop drawings.

20.1.3. Certificate(s) of acceptance from authorities having jurisdiction

20.1.4. Verification reports and certificate(s) for any new fire alarm components or tie-ins and any base building tie-ins for miscellaneous systems (i.e. security, lighting control, digital metering).

20.1.5. Data/communication drawings, test reports, and installation details.

20.1.6. Written warranty - five years for labour and materials.

20.1.7. As-built drawings.

20.2. Review information provided in the maintenance instructions and manuals with the tenant's operating personnel and landlord's operating personnel where base building systems are revised, to ensure a complete understanding of the electrical equipment and systems and their operation.

PART 21 PRODUCTS - INTRUSION

21.1. Door Contacts

21.2. Match new door contacts to existing.

21.3. Motion Sensors

21.4. Match new motion sensors to existing.

21.5. Intrusion Panel

21.6. Existing Intrusion panel shall be reused.

21.7. Provide cabling for all new and reinstalled devices.

PART 23 GENERAL INSTALLATION

23.1. Provide all cameras, supporting active network equipment and management software as described in this specification and as quantified in locations on floor plans.

23.2. Contractor shall provide up to two visits to each camera to re-orient camera field of view as directed by owner.

23.3. Contractor shall coordinate with owner for the naming of all cameras.

23.4. All camera cabling shall be within minimum ¾" conduit. Follow electrical best practices and applicable codes for conduit installations.

PART 26 WARRANTY AND RESPONSE TIME

26.1. Provide a minimum 2 year warranty for all labour and materials.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 10 - Closeout Procedures.

.3 Section 26 05 00 - Common Work Results for Electrical.

.4 Section 26 05 21 - Wires and Cables (0 - 1000 V).

.5 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

.1 Government of Canada

.1 NBC, National Building Code of Canada, latest edition.

.2 TB OSH Chapter 3-3, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-3, Fire Protection Standard for Electronic Data Processing Equipment.

.3 TB OSH Chapter 3-4,Treasury Board of Canada, Occupational Safety and Health, Chapter 3-4, Standard for Fire Alarm Systems.

.2 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524, Installation of Fire Alarm Systems.

.2 ULC-S525, Audible Signal Appliances for Fire Alarm.

.3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527, Control Units, Fire Alarm.

.5 CAN/ULC-S528, Manual Pull Stations.

.6 CAN/ULC-S529, Smoke Detectors, Fire Alarm.

.7 CAN/ULC-S530, Heat Actuated Fire Detectors, Fire Alarm.

.8 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.

.9 CAN/ULC-S537, Verification of Fire Alarm Systems.

.10 CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.3 SYSTEM DESCRIPTION

.1 The fire alarm system scope of work is expansion of existing fire alarm system installed in main house at entrance vestibule.

.2 Devices shall be installed according to CAN-CSA latest edition and the requirements of the local authorities having jurisdiction.

.3 All wiring shall be installed in conduit and to conform to the requirement of the Ontario Electrical Safety Code, latest edition or local code having jurisdiction. Provide a ground wire in all conduits.

.4 Contract base building fire alarm contractor to install all devices and make final connections to fire alarm panel.

.5 Ensure that the nomenclature of annunciator's identification nameplates, are verified with the owner and authorities prior to ordering.

.6 All work on the fire alarm system to be performed by a certified fire alarm technician.

.7 When the fire alarm system is complete, obtain the services of base building fire alarm manufacturer to make a complete inspection and verifications of all installed fire alarm equipment and devices.

.8 Perform any changes necessary as a result of the above verification and inspection in accordance with the manufacturer's directions.

.9 On completion of the verification, inspection and testing obtain the verification certificate and inspection reports from the manufacturer and forward to the owner.

.10 Fire alarm signaling devices to be installed and tested in compliance with Ontario Building Code (latest edition) section 3.2.4.20. (audibility).

.1 For speakers, set at 0.5 watt tap and modify up if required to achieve audibility. Tap setting shall not be set at or increased to cause the sound pressure level to be more than 100 dBA when measured 3m from the device.

.2 For horns with adjustable volume settings, set at mid volume and modify up if required to achieve audibility. Volume setting shall not be set at or increased to cause the sound pressure level to be more than 100 dBA when measured 3m from the device.

.11 Ensure that all costs for the above testing, verification, inspection are included in the tender price.

.12 Where the integrity of the existing life safety input and output devices are affected due to relocations, ceiling demolitions and/or re-installations onto new suspended ceiling, electrical contractor shall be responsible to maintain the system operation at all times. All suspension accessories required for the installation (e.g., mounting channels and frames, etc.) and verification of the system shall be included in the tender prices.

.13 Testing and commissioning of the integration of all life safety and fire protection systems shall be required. Follow the guidelines as outlined in the CAN/ULC-S1001 standard. Where applicable, the testing of the integrated systems shall include, but not limited to the following systems:

.1 Fire Alarm

.2 Mass Notification
.3 Elevators
.4 Emergency Generators and/or Inverters
.5 Audio/Visual
.6 Lighting Control
.7 Notification (i.e. “Fire Do Not Enter” signage, etc.)
.8 Standpipe
.9 Water Supplies and/or Control Valves
.10 Freeze Protection
.11 Cooking Equipment Fire Suppression
.12 Hazardous Protection Monitoring
.13 Smoke Alarms
.14 Emergency Lighting

The Contractor shall be responsible for performing and providing a commissioning report of all the applicable systems installed, that they have been tested as a whole to ensure the proper operation and inter-relationship between the systems. Include for all costs in the tender prices.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

1.2 Labour, Products, equipment and services necessary for earthwork Work in accordance with the Contract Documents.

1.3 FIELD MEASUREMENTS

.1 Verify that survey bench mark and intended elevations for the Work are as indicated.

1.4 DESCRIPTION OF THE EXCAVATION AND BACKFILLING WORK

.1 Work of this comprises excavation of parking areas, building foundations, and placing and compaction of any granular materials noted on the section drawings to create mew parking areas ready for placing stone paving (surface treatment) shown on the contract drawings. Dispose of excess excavated materials off site.

.2 Division of the Work among Subcontractors is solely the Contractor's responsibility.

1.5 SUBMITTALS

.1 Reports:

.1 Submit written laboratory test reports.

.2 Submit written field inspection and test report results after each inspection.

.2 Submit dewatering methods 30 days in advance for review by Consultant.

.3 Submit to Consultant details of locations where surplus soils and other materials are to be disposed of or reused. Include each disposal/reuse Site and type of surplus soil or other material, location of the disposal/reuse Site, operator's name and business address, type of license under which Site operates, and criteria used by Site to access suitability of surplus material for disposal.

.4 Submit to Consultant, within 48 hours of a load of surplus soil or other material leaving the Site, a daily register recording the time and place of disposal/reuse of each load signed by a representative of the disposal site. Such documentation must be submitted before payment for excavation will be made.

1.6 QUALITY ASSURANCE

.1 Have shop drawings signed and sealed by a Professional Engineer licensed in Province of Ontario and having experience in design and inspection of shoring, bracing and underpinning required to complete Work.

1.7 SITE CONDITIONS

.1 Geotechnical conditions: For information on subsurface conditions refer to document appended to Section 02 32 00.

.2 Cultural heritage resources: If Cultural Heritage Resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.

1.8 PROTECTION OF WORK

.1 Existing buried utilities and structures:

.1 Size, depth and location of known existing utilities and structures are indicated for guidance only. Completeness and accuracy is not guaranteed.

.2 Prior to commencing any excavation Work, have authorities stake out utility locations to prevent disturbance during Work.

.3 Confirm locations of buried utilities by careful test excavations. Hand dig test excavations as necessary.

.2 Existing buildings and surface features:

.1 Conduct with Consultant, a condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by Work.

.2 Protect existing buildings and surface features which may be affected by Work from damage while Work is in progress and repair damage resulting from Work.

.3 Where excavation necessitates root or branch cutting, perform Work in accordance with Authorities having Jurisdiction.

.4 Confirm with Consultant, condition Survey of buildings and structures undertaken by Consultant.

.3 Temporarily cover local existing catch basins and maintenance holes to prevent entry of earth or debris. Ensure adequate surface drainage in affected area is maintained.

.4 Protect Work or work of other Contracts in progress or completed and protect existing properties, stored Products, services, utilities, trees, landscaping and natural features from damage.

.5 Protect excavations against flooding and damage and install and maintain appropriate warning devices during construction and during time when Work is closed down for any cause.

.6 Protect bottom of excavations that will support foundations, slabs, pavements etc. from frost or freezing.

.7 Keep access roads clear of debris and dirt resulting from Work of this Section to acceptance of Authorities having jurisdiction.

.8 Shoring, bracing and underpinning: Comply with local regulations, authorities having jurisdictions and requirements specified.

PART 2 Products

2.1 MATERIALS

.1 Select fill: Subject to approval of Consultant consisting of reusable fill excavated from Site or imported fill that is free of organic matter, rubble and material other than soil. Maximum particle size of half thickness of lift specified, moisture content at time of placing 2% maximum over its optimum moisture content and is either non plastic or has a plasticity index of 25% maximum.

.2 Granular A fill: Imported Granular A fill, free of organic matter and, in accordance with OPSS 1010.

.3 Granular B Fill: Imported Granular B fill free of organic matter and in accordance with OPSS 1010.

.4 Engineered fill: Clean, hard, durable crushed rock or stone, free of shale, clay, organic material, recycled material or any other deleterious substance. Engineered fill shall be in accordance with OPSS 1010 Granular B Type II. Moisture content shall be within 2% of Optimum Moisture Content in accordance with ASTM D698

.5 Granular D fill: In accordance with OPSS-1004, containing 100% crushed aggregates, free of organic matter.

.6 Clear Stone fill: 19 mm clear stone in accordance with OPSS 1004, free of organic material.

.7 Unshrinkable fill: 0.7 MPa cement stabilized backfill conforming to requirements of CAN/CSA A23.1/A23.2-M.

PART 3 Execution

3.1 LINES AND ELEVATIONS

.1 Establish lines and elevations from Control Points shown on Contract Drawings.

.2 Have lines and elevations established by Registered Ontario Land Surveyor or qualified Civil Engineer registered in Province of Ontario.Notify utility company to remove and relocate utilities.

.3 Protect and maintain Control Points and Bench Marks as long as they are required.

3.2 STRIPPING

.1 Do not handle topsoil while in wet or frozen condition or in manner in which soil composition is adversely affected

.2 Strip topsoil from working area in locations shown.

.3 Strip topsoil to depths indicated. Avoid mixing topsoil with subsoil.

.4 Stockpile topsoil in locations directed by Consultant. Stockpile to height not exceeding 2 m.

3.3 REMOVAL OF WATER

.1 Obtain letter of conditional approval from Authorities having Jurisdiction to dispose of ground water into sewer drainage system. Apply for and pay for water disposal permit.

.2 Keep excavations and trenches free of water throughout construction period.

.3 Groundwater removal:

- .1 Lower groundwater level and maintain at depth below lowest point of excavation to ensure a dry stable surface.
- .2 Dewater to prevent loss of soil and maintain stability of sides and bottom of excavation and of adjacent structures.
- .3 Dispose of water in conformance with applicable by-laws and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
- .4 Supply and install flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to sewers, water courses or drainage areas in accordance with authorities having jurisdiction. Perform testing on settlement tank discharge to confirm that effluent meets sewer bylaw requirements. Locate tanks to acceptable area determined by Consultant.
- .5 Should method of dewatering fail to achieve conditions specified above, Consultant reserves right to revise methods and procedures at no cost to Owner.

.4 Surface water removal:

- .1 Remove surface run-off in a manner that will prevent loss of soil and maintain stability of sides and bottom of excavation. Obtain Consultant's approval of dewatering method to be used.
- .2 Discharge surface water into existing storm drainage system to acceptance of Consultant and local authorities.

.5 Do not obstruct flow of surface drainage or natural water courses.

3.4 EXCAVATING

.1 Remove concrete, masonry, paving, demolished foundations and rubble and other obstructions encountered during excavation Work.

.2 Do not disturb soil within drip line of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw in a manner acceptable to authorities having jurisdiction.

.3 Excavate to required lines and grades shown on Contract Drawings with allowance for subsequent Work including shoring, bracing and formwork. Make excavation clean and clear of loose material and true to size.

.4 Protect stockpiles of fill against contamination and moisture absorption.

.5 Do not undermine adjacent structures. Where it is necessary to have footings at different levels, found upper footing below imaginary 10-horizontal-to-7 vertical line, or as otherwise indicated, drawn up from base of lower footing. Protect adjacent foundations from frost.

.6 Have excavations in excess of 1200 mm in depth conform to requirements of Occupational Health and Safety Act, and Regulations for Construction Projects.

.7 Do not expose shale at subgrade elevation to drying cycles and in any case, following inspection, cover with minimum 50 mm of lean concrete within 4 hours after exposure.

.8 Fill excavations for foundations which are, through error, carried below elevation shown or approved depth, with 15 MPa concrete, or as directed by Consultant.

.9 Trim, and remove loose material, debris and organic material from excavations.

.10 Where material at bottom of excavation is disturbed, remove disturbed material and re-compact to density equal to or better than undisturbed soil or backfill with lean concrete as directed by Consultant.

.11 When excavations are complete, prior to commencement of subsequent Work, request Consultant for inspection of excavation Work.

.12 Excavation of rock shall be by hoe-ramming, jack-hammering or other machine method appropriate to conditions. Blasting will not be permitted.

3.5 TRENCHING

.1 Excavate trenches to lines and grades indicated and to a depth of 75 mm minimum below invert elevation and slope established for pipe, and backfill to invert elevation of pipe with specified granular material.

.2 Unless otherwise authorized by Consultant, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation. Remove unsuitable material from trench bottom to extent and depth as directed by Consultant.

.3 Backfill Over-excavation with granular material and compact.

.4 If unstable soil conditions are encountered, excavate trenches to depth directed by Consultant and backfill to correct elevation with backfill material.

.5 Remove loose material from bottom of trenches to ensure granular material is placed against undisturbed soil.

.6 Compact bedding and grade as required for even and uniform support on each length of pipe.

.7 Where excavating is required adjacent to and parallel with and below any footing, submit excavation and backfill procedures to Consultant for review prior to start of excavating

.8 Keep width of trenches to a minimum to ensure minimum span for pipe to be supported.

.9 Make excavations for fire hydrants of sufficient size and depth to accommodate a minimum 0.75 m^3 of crushed stone. Hand place stone and tamp around and below hydrant elbow to ensure proper drainage of hydrant.

3.6 EXCAVATED MATERIAL DISPOSAL

.1 Except for material to be used as select fill, immediately remove and dispose of excavated material from Site.

.2 Remove and dispose of construction rubble, abandoned gas, water and sewer pipes, valves, valve boxes and fittings, maintenance holes, frames and covers and other material which may be encountered during excavation but not indicated on Contract Drawings.

3.7 ENGINEERED FILL

.1 Provide engineered fill below foundations in accordance with recommendations contained in the geotechnical report. The engineered fill at footing level must extend horizontally 1.2 m beyond edge of footings beyond which point the sides of the engineered fill zone may be sloped at 1 vertical to 1 horizontal.

.2 Place engineered fill in layers not exceeding 200 mm in the uncompacted state.

.3 Compact each layer to a minimum of 100% Standard Proctor Density in accordance with Section ASTM D698.

.4 Use mechanical compaction equipment that is appropriate for the material being placed.

.5 Provide a minimum of 24 hours notice to the inspection and testing company to arrange for compaction testing for each layer of fill.

.6 Do not place next lift of fill until previous lift has been tested and found to be adequately compacted in accordance with the specified level of compaction.

.7 Confirm elevations of top of engineered fill layer upon completion of placement and compaction.

.8 Protect surface of engineered fill from any disturbance.

.9 Do not place fill during period of freezing ambient temperature.

.10 Remove and replace fill until compaction test reports by the testing agency are satisfactory to the Consultant.

3.8 BEDDING FOR SLABS ON GRADE

.1 Provide bedding for slabs on grade, including basement floor slabs, consisting of a minimum 150 mm layer of well-compacted clear stone. The clear stone bedding shall be placed on engineered fill of bedrock and not on existing fill.

3.9 BACKFILLING

.1 Do not proceed with backfilling operations until walls, slabs, waterproofing and below grade Work has been inspected and accepted by Consultant.

.2 Backfill areas which are free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Do not backfill on or against any membrane or protection board covered waterproofing with jagged rock or other sharp objects which might damage waterproofing.

.5 Limit vertical drop of backfill material to 2000 mm.

.6 To avoid pockets and voids, remove sheathing and shoring materials that require removal, as backfilling progresses.

.7 Prior to backfilling or placing concrete on exposed soil subgrade, proof roll subgrade to identify soft or loose areas. Proceed with placing backfill or concrete only after inconsistencies identified by above procedure have been reworked and compacted or excavated, backfilled and compacted as required to eliminate such conditions to acceptance of Consultant.

.8 Place backfill material, grade and compact to levels shown on Contract Drawings.

.9 Place backfill materials in uniform layers 200 mm maximum loose thickness unless specified otherwise.

.10 Ensure each layer is compacted, and accepted by Consultant, before placing succeeding layers.

.11 Unless otherwise indicated, use specified granular material from bottom of trench to 300 mm above top of pipe or 150 mm above top of electrical conduits. Hand place in 150 mm layers and compact carefully to ensure proper backfilling and compaction around bottom quadrants and sides of pipe.

.12 For backfill from 300 mm above top of pipe or 150 mm above electrical conduits to sub-grade level, use select fill unless otherwise noted. Compact either by hand or by machine.

.13 Do not backfill trenches until piping, conduits and cables therein have been inspected, tested, and approved by inspection authorities having jurisdiction and Consultant.

.14 Prior to backfilling of trenches, remove wood block or wedges used to prevent movement of piping during tests.

.15 Where there is a common boundary between select fill and granular fill or unshrinkable fill, place select fill after granular fill has been compacted. Place and compact fill around free standing structures evenly on all sides of structure simultaneously in layers sloping away from structure.

.16 During backfilling, take care to avoid displacing or damaging Utilities Work and Services.

.17 Notify Consultant prior to commencement of backfilling and compacting operations.

3.10 COMPACTION

.1 Compaction densities for select fill, granular fill, and sand fill materials will be determined by ASTM D698. Compaction densities for clear stone and pea gravel will be determined by ASTM D4253.

.2 Add water if necessary to obtain required densities. Correct irregularities or depressions that may develop during compaction by removing or adding material to form a smooth and uniform surface.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.4 If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers acceptable to Consultant.

.6 Compact backfill materials in accordance with Geotechnical Report providing the following as a minimum:

.1 Imported fill: 98% standard Proctor maximum dry density (SPMDD).

.2 Under slabs, walks and pavements: 100% (SPMDD).

.3 All other areas: 95% (SPMDD).

3.11 GRADING

.1 Prior to placing fill over existing ground, scarify surface to depth of 150 mm.

.2 Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.3 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice. Ensure no frozen material is used in placing.

.4 Grade as necessary to bring Work areas to required elevations. Supply additional material required to obtain new grade levels. Place and compact as specified.

.5 Grade drainage ditches to elevations indicated on Contract Drawings.

.6 Maintain positive drainage.

.7 Grade materials using methods which do not lead to segregation or degradation of aggregate.

.8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace that portion of layer in which material becomes segregated during spreading.

.10 Slope grade away from buildings 1:50 minimum.

.11 Make graded areas smooth to profile, free of debris, with local excavations and depressions filled and compacted.

.12 Do not disturb soil within branch spread of trees and shrubs remaining.

.13 Cultivate entire area which is to receive topsoil to a depth of 100 mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.

.14 Remove surface debris, roots, vegetation, branches and stones in excess of 50 mm in diameter.

3.12 FINISH GRADING

.1 Fine grade and loosen topsoil. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Roll to consolidate topsoil for areas to be seeded or sodded leaving surface smooth, uniform, firm against deep foot printing, and with fine loose texture to approval of Consultant.

3.13 UNSHRINKABLE FILL

.1 Place unshrinkable fill in locations indicated on Contract Drawings or where Work area is too limited to permit proper placing and compaction. Obtain Consultants approval prior to placing unshrinkable fill. Place in accordance with supplier's written instructions.

.2 If embedded items occur in area being backfilled, coordinate with appropriate trades to ensure that disturbance of embedded items during backfilling is prevented.

3.14 RESTORATION

.1 Upon completion of Work, remove surplus materials and debris, trim slopes, and correct defects as directed by Consultant.

.2 Replace topsoil and reinstate existing pavement, sidewalk, lawns and walks to elevation and condition which existed before excavation.

.3 Clean and reinstate areas affected to acceptance of Consultant.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-Place Concrete
.2 Section 31 23 33 - Excavating, Trenching and Backfilling
.3 Section 32 16 00 – Concrete Paving

1.2 MEASUREMENT FOR PAYMENT

.1 Aggregate materials will be paid as part of the applicable surfacing, including but not limited to excavation work, base aggregate layers, remedial grading, paving. Refer to applicable specification sections for inclusion of this item into the measurement for payment.

1.3 REFERENCE

.1 Society for Testing and Materials (ASTM)
  .1 American Current ASTMC117, Test Method for Material Finer Than 0.075mm Sieve in Mineral Aggregates by Washing.
  .2 Current ASTMC127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.
  .3 Current ASTM C 136, Method for Sieve Analysis of Fine and Coarse Aggregates.
  .4 Current ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN- m/m^3).
  .5 Current ASTM D698, Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. (2.49-kg) Rammer and 12-in (304.8-mm) Drop
  .6 Current ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700kN-m/m^3).
  .7 Current ASTM D4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
  .8 Current ASTM D4791- [99], Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
  .9 ASTM E11, Specification for Wire - Cloth Sieves for Testing Purposes.
  .10 Current ASTM F355-95, ASTM F1292-99 (Playground Sand)

.2 Canadian General Standards Board (CGSB)
  .1 Current CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
  .2 Current CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA)
- .1 Current CAN/CSA-A5, Portland Cement.
- .2 Current CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .3 Current CSA A82.56, Aggregate for Masonry Mortar.
- .4 Current CAN/CSA Z614-98 (Playground Sand).

.4 Ontario Provincial Standard Specifications (OPSS)
- .1 Current OPSS 1010 – Aggregates for Granular O, A, B, M and Select Subgrade Materials.

1.4 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit to the Contract Administrator, samples of material for sieve analysis at least three (3) weeks before commencing asphalt works.

1.5 TESTING

.1 Contact the testing agency for compaction and materials tests as per Section 01 45 00 – Quality Control.

.2 Testing to be conducted for this section of work is as follows:
- a) Sieve designation of specified aggregate.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Place materials defined as hazardous or toxic in designated containers.

PART 2 Products

2.1 MATERIALS

.1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.

.2 Flat and elongated particles of coarse aggregate: to ASTM D4791.

.3 Aggregate materials to satisfy the following requirements:

.1 Granular Base.

.1 Granular A.

.1 As described in current OPSS 1010 – Aggregates for Granular O, A, B, M and Select Subgrade Materials.

.2 Consisting of hard, durable, angular particles; free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.3 Gradations: within limits specified when tested to current ASTM C 136 and ASTM C 117. Sieve sizes to current CAN/CGSB-8.1 rather than ASTM E 11.

.4 Liquid Limit current ASTM D 4318 Maximum 25.

.5 Plasticity Index current ASTM D 4318 Maximum 6.

.6 Table

Sieve Designation (mm)	% Passing
19	100
12.5	70-100
4.75	40-70
2	23-50
0.425	7-25
0.075	3-8

.2 19mm crusher run limestone.

.2 Granular Sub-Base.

.1 Granular B.

.1 As described in current OPSS 1010 – Aggregates for Granular O, A, B, M and Select Subgrade Materials.

.2 Crushed pit run, screened stone, gravel or sand.

.3 Hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.4 Gradations: within limits specified when tested to current ASTM C 136 and ASTM C 117. Sieve sizes to current CAN/CGSB-8.1 rather than ASTM E 11.

.5 Table:

Sieve Designation (mm)	% Passing
75	100
4.75	25-85
0.425	5-30
0.075	0-10

2.2 SOURCE QUALITY CONTROL

.1 Inform Contract Administrator of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.

.2 If, in opinion of the Contract Administrator, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.3 Advise Contract Administrator 4 weeks in advance of proposed change of material source.

.4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 Execution

3.1 PREPARATION

.1 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified.

.3 Wash aggregates, if required to meet specifications.

.4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.

.2 HANDLING

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

.3 STOCKPILING

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by the Contract Administrator. Do not stockpile on completed pavement surfaces.

.2 Stockpile aggregates in sufficient quantities to meet project schedule.

.3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.4 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

.5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Contract Administrator within 48h of rejection.

.6 Stockpile materials in uniform layers of thickness as follows:

.1 Max 1.5m for coarse aggregate and base course materials.
.2 Max 1.5m for fine aggregate and sub-base materials.
.3 Max 1.5m for other materials.

.7 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.8 Do not cone piles or spill material over edges of piles.

.9 Do not use conveying stackers.

.10 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.2 CLEANING

.1 Restore stockpile areas to pre-construction condition or as otherwise specified.

.2 Dispose of any unused aggregates.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 All Division 1 Specification Sections
.2 Section 31 05 16 – Aggregate Materials
.3 Section 31 11 00 - Clearing and Grubbing.
.1 Section 31 23 33 - Excavation, Trenching and Backfilling.
.2 Section 31 31 19.01 - Geotextiles
.3 Section 32 91 19.13 – Topsoil Placement and Fine Grading

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 Current ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m^3).

1.3 MEASUREMENT FOR PAYMENT

.1 Site grading will be measured as specified in the pricing summary which includes disposal of any surplus materials from the site and/or the importation of approved soil to meet the design grades.

.2 Supply and installation of silt fencing will be measured as specified in the pricing summary.

1.4 EXISTING CONDITIONS

.1 Verify underground and surface utility lines and buried objects that are indicated on drawings.

.2 Refer to dewatering in Section 31 23 33 – Excavation, Trenching and Backfilling.

1.5 PROTECTION

.1 Protect existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as indicated on drawings. If damaged, restore to original or better condition.

.2 Protect newly graded and filled areas from washouts and settlement caused by rain and water drainage. Correct any damage as necessary.

.3 Maintain access roads to prevent accumulation of construction related debris on roads.

.4 Place filter fabric over catch basins and manholes to prevent clogging with sediment during the rough and fine grading operations. Maintain filter fabric clean of sediment throughout the duration of construction.

PART 2 Products

2.1 MATERIALS

.1 Excavated or graded material existing on site, including surficial topsoil as described in the soils report, shall be used as fill for grading work. Only structural grade fill approved by the geotechnical Contract Administrator shall be utilized under paved surfaces, walls and foundations.

.2 Fill material Type in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling and Section 31 05 16 – Aggregate Materials.

PART 3 Execution

3.1 ROUGH GRADING

.1 Verify rough grades and notify the Contract Administrator of discrepancies prior to performing work.

.2 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated on drawings.

.3 Ensure positive drainage at all times throughout the site and notify the Contract Administrator immediately of problem/ponding areas.

.4 Rough grade to specific depths below finish grades as indicated on drawings.

.5 Place fill material in maximum 250mm lifts.

.6 Slope rough grade away from buildings/structures.

.7 Grade slopes for landscape areas to a maximum of 3:1 unless otherwise specified on drawings where slopes exceed 3:1 to meet design requirements.

.8 Grade ditches and swales to depths indicated on drawings. Ensure gradient transitions are smooth and drain in the direction indicated on drawings.

.9 Prior to placing fill over existing ground, scarify surface to depth of 150mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.10 Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows:

.1 85% under landscaped areas.
.2 100% under paved and walk areas.
.3 As otherwise specified in the Geotechnical Report or indicated on drawings.

.11 Finished rough-grade surface to be free of debris or stones larger than 50mm diameter.

.12 Clean surplus soil may be utilized on site at the discretion of the Contract Administrator. All other materials shall be removed off site at the contractor's expanse.

3.2 VERIFICATION OF CONSTRUCTED ROUGH GRADE

.1 Provide the Contract Administrator with "as built" shots in accordance with grade verification plan to verify that constructed rough grades are in accordance with drawings. Correct discrepancies to the approval of the Contract Administrator.

.2 Obtain approval from Contract Administrator of rough grades before commencing finish grading.

3.3 TESTING

Carry out materials and compaction tests in accordance with Section 01 45 00 - Quality Control.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 All Division 1 Specification Sections.
.2 Section 31 05 16 – Aggregate Materials.
.3 Section 31 22 13 - Rough Grading.
.4 Section 31 32 19.01- Geotextiles.

1.2 MEASUREMENT FOR PAYMENT

.1 Measurement for excavation, trenching and backfill will be included with the specific item of installed work or furnishing as noted in the pricing summary.

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB)
  .1 Current CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
  .2 Current CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.2 Canadian Standards Association (CSA)
  .1 Current CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.

1.4 DEFINITIONS

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

  .1 Rock : any solid material in excess of $0.25m^3$ and which cannot be removed by means of mechanical excavating equipment having a 0.95 m^3 to $1.15m^3$ bucket. Frozen material not classified as rock.

  .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Unclassified excavation: excavation of deposits of whatever character encountered in work.

.3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.4 Waste material: excavated material unsuitable for use in work or surplus to requirements.

.5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work.

.6 Unsuitable materials:

.1 Weak and compressible materials under excavated areas.
.2 Frost susceptible materials under excavated areas.
.1 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.

.7 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.5 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.6 PROTECTION OF EXISTING FEATURES

.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing excavation work, notify applicable owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by obtaining a certified utility stakeout.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.5 Where utility lines or structures exist in area of excavation, obtain direction of the Client before removing or re-routing.

.6 Record location of maintained, re-routed and abandoned underground lines.

.2 Existing buildings and surface features:

.1 Conduct a survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by work.

.2 Protect existing buildings and surface features from damage while work is in progress. In event of damage, immediately make repair to approval of the Contract Administrator.

PART 2 Products

2.1 MATERIALS

.1 Type 1 and Type 2 fill as per Section 31 05 16 – Aggregate Materials.

.2 Type 3 Fill: selected material from excavation or other sources, approved by the Contract Administrator for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Impervious Fill.

.4 Unshrinkable Fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.
.2 Maximum Portland cement content of 25 kg/m ^{3}.
.3 Minimum strength of 0.07 MPa at 24 h.
.4 Concrete aggregates: to CAN/CSA-A23.1.
.5 Portland cement: Type 10.
.6 Slump: 200mm.

.5 Geotextiles: to Section 31 32 19.01 - Geotextiles.

PART 3 Execution

3.1 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 STOCKPILING

.1 Stockpile fill materials in designated areas.

.2 Stockpile granular materials in manner to prevent segregation.

.3 Protect fill materials from contamination.

3.3 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while work is in progress.

.2 Submit for Contract Administrator approval, details of proposed de-watering or heave prevention methods such as dikes, well points, and sheet pile cut-offs.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water in accordance with Section 01 35 43 - Environmental Protection and in a manner not detrimental to public and private property, or any portion of work completed or under construction.

.6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas.

3.4 EXCAVATION

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.

.3 Excavation must not interfere with normal 45º splay of bearing from bottom of any footing.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.5 For trench excavation, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 5m at end of day's operation.

.6 Dispose of surplus and unsuitable excavated material off site.

.7 Do not obstruct flow of surface drainage or natural watercourses.

.8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.9 Notify Contract Administrator when bottom of excavation is reached.

.10 Remove unsuitable material from trench bottom to extent and depth as directed by Contract Administrator

.11 Obtain Contract Administrator approval of completed excavation.

.12 Correct unauthorized over-excavation with no additional cost to the Client as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings.
.2 Fill under other areas with Type 2 fill compacted to not less than 98 % of corrected maximum dry density.

.13 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of the Contract Administrator

.14 Install geotextiles in accordance with Section 31 32 19.01 - Geotextiles

3.5 FILL TYPES AND COMPACTION

.1 Use fill of types as indicated or specified below. Compaction densities are percentages of maximum densities obtained from corrected maximum dry density.

.1 Under concrete slabs: provide compacted base course of Type 1 fill to underside of slab. Compact base course to 98% SPD. Refer to project detail for profile thickness.

3.6 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.7 BACKFILLING

.1 Use suitable vibratory compaction equipment.

.2 Do not proceed with backfilling operations until the Contract Administrator has inspected and approved installations.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 150mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfill around installations.

.7 Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators.

.1 Place bedding and surround material as per specific details.

.2 Do not backfill around or over cast-in-place concrete within 48 hours after placing of concrete.

.3 Place layers simultaneously on both sides of installed work to equalize loading.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 Permit concrete to cure for minimum 28 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from the Client or:

.2 If approved by the Contract Administrator, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by the Contract Administrator

.8 Install drainage system in backfill as indicated.

.9 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

3.8 RESTORATION

.1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as indicated.

.2 Replace topsoil as indicated.

.3 Clean and reinstate areas affected by work to condition which existed before excavation.

.4 Reinstate prescribed surface materials to elevation which existed before excavation.

.5 Reinstate road pavement, sidewalks, lawns and plantings to condition which existed before excavation.

.6 Comply with Detail OPSD 600.040 to reinstate concrete curbs.

.7 Comply with Detail OPSD 310.010 to reinstate concrete sidewalks.

END OF SECTION

PART 1 General

1.1 WORK IN THIS SECTION

.1 Labour, products, equipment and services necessary for granular base in accordance with the Contract Documents.

.2 The supply and installation of granular base shall include the following items of work, but not limited to:

.1 Supply, placement and compaction of Granular 'A' for concrete and asphalt paving.

.2 Compaction testing

.3 Supply of water and calcium chloride for compaction and dust control.

1.2 REFERENCE

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C 117-95, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C 131-96, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM C 136-96a Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).

.5 ASTM D 1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).

.6 ASTM D 1883-99, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTM D 4318-00, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Ontario Provincial Standard Specification OPSS 1010

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Coordinate delivery and stockpiling of materials with Contract Administrator and Owner.

.2 Divert unused granular material from landfill to local facility as approved by Contract Administrator.

PART 2 Products

2.1 MATERIALS

.1 In accordance with Section 31 05 16 Aggregate Materials.

PART 3 Execution

3.1 SEQUENCE OF OPERATION

.1 Place granular base after rough grading to sub-base elevation is inspected, proof rolled and approved by Contract Administrator.

.2 PLACING

.1 Construct granular base to depth and grade in areas indicated on Contract Drawings.

.2 Ensure no frozen material is placed.

.3 Place material only on clean unfrozen surface, free from snow and ice.

.4 Place material using methods which do not lead to segregation or degradation of aggregate.

.5 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.

.6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Contract Administrator may authorize thicker lifts (layers) if specified compaction can be achieved.

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace that portion of layer in which material becomes segregated during spreading.

.3 Compaction Equipment

.1 Compaction equipment to be capable of obtaining required material densities.

.4 Compacting

.1 Compact to density not less than 100% corrected maximum dry density ASTM D 698.

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Contract Administrator.

3.2 SITE TOLERANCES

.1 Finished Granular ‘A’ surface and Granular ‘B’ sub-surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

.2 Correct surface irregularities in accordance to satisfaction of Contract Administrator.

3.3 **PROTECTION**

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Contract Administrator.

3.4 **PROTECTION**

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Contract Administrator.

3.5 **TESTING**

.1 Contact the testing agency for compaction and materials tests as per Section 01 45 00 – Quality Control.

3.6 **VERIFICATION OF installed aggregate base layers**

.1 Provide the Contract Administrator with “as built” shots in accordance with grade verification plan to verify that constructed aggregate base-layer grades are in accordance with drawings. Correct discrepancies to the approval of the Contract Administrator.

.2 Obtain verification of compaction requirements via. Third-party geotechnical testing agency.

.3 Obtain approval from Contract Administrator of rough grades and compaction before commencing finish grading and/or paving/surfacing.

END OF SECTION

PART 1. General

1.1 RELATED SECTIONS

.1 Conform to the requirements of Division 1.
.2 Section 03 20 00 Concrete Reinforcing
.3 Section 03 30 00 Cast-in-Place Concrete.
.4 Section 32 11 23 Aggregate Base Courses
.5 Section 31 23 13 Rough Grading

1.2 REFERENCES

.1 Canadian Standards Association (CSA).

.1 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-1.2, Boiled Linseed Oil.
.2 CAN/CGSB-3.3, Kerosene.

.3 American Society for Testing and Materials (ASTM).

.1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).
.2 ASTMD2628, Standard Specification for Performed Polychloroprene Elastomeric Joint Seals for concrete Pavements.
.3 ASTM C979/C979M-16 Standard Specification for Pigments for Integrally Colored Concrete.

1.3 TESTING

.1 Testing of concrete to CAN3-A23.1 and requirements of Section 03 30 00 – Cast-in- Place Concrete.

1.4 ENVIRONMENTAL CONDITIONS

.1 If temperature is below 5˚C or if Owner's Representative anticipates a temperature drop below this value within the next 24 hours, take all necessary measures to protect concrete from freezing.

.2 Do not place concrete on frozen base.

1.5 SUBMITTALS AND MOCKUPS

.1 Submit colour admixture sample for coloured concrete paving. Colour to be a medium-dark grey. Design based on Lafarge 'Twilight' Artevia colour blend.

.2 Pour sample panel for 'FINISH TYPE 1 concrete paving 900x900x150mm including edging and finishing for approval by consultant. Do not pour any further 'FINISH TYPE 1' concrete paving until cured mock-up has been deemed acceptable. Maintain sample panel on site until final acceptance of light-duty concrete paving following which the Contractor is to remove and dispose of the panel off-site and restore the area.

PART 2. Products

2.1 MATERIALS

.1 Concrete mixes and materials: refer to Section 03 30 00 – Cast-in-Place Concrete.

.2 Reinforcing steel: refer to Section 03 20 00 - Concrete Reinforcing.

.3 Joint filler: refer to Section 03 30 00 - Cast-in-Place Concrete.

.1 20 mm preformed, non-extruding, resilient bituminous type throughout medium and light duty concrete paving areas.

.4 Granular base: to Section 32 11 23 – Aggregate Base Courses and to Section 31 23 10 - Excavating, Trenching and Backfilling.

.5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

.6 Fill material: to Section 31 23 10 - Excavating, Trenching and Backfilling.

.7 Clear, polyethylene film to ASTM C171, minimum thickness 0.10 mm.

.8 Colour Admixtures:

.1 In accordance with ASTM C979/C979M-16 Standard Specification for Pigments for Integrally Colored Concrete.

.2 Lafarge 'Twighlight' (medium-dark blue) or approved alternative. Colour selection to be confirmed by Client and Landscape Consultant based on Contractor provided samples.

.3 Rate and mixing for uniform dispersion by manufacturer recommendations.

.4 Always add ingredients in the same order for each batch.

PART 3. Execution

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.2 Construct embankments using excavated material free from organic matter or other objectionable materials. Dispose of surplus and unsuitable excavated material off site.

.3 Place fill in maximum 150 mm layers and compact to 100% of maximum density to ASTM D698.

.4 Ensure that Sub Grade, Granular Sub-Base and Granular Base preparation has been inspected and approved by Third-Party Testing Agency and Owner's Representative before commencing work.

3.2 GRANULAR SUBBASE

.1 Obtain Owner's Representative approval and approval by Third-Party Testing Agency of subgrade before placing granular subbase.

.2 Place granular subbase material in accordance with Section 32 11 23 – Aggregate Base Courses.

3.3 FORMING

.1 Securely position forms to required lines and grades.

.2 Coat forms with form release agent.

.3 Obtain approval of forms before placing concrete.

.4 Install metal reinforcement as required.

3.4 MEDIUM & LIGHT DUTY CONCRETE PAVING

.1 Obtain Owner's Representative approval of granular base and reinforcing steel prior to placing concrete.

.2 Concrete work to be completed in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Finishes:

.1 Type 1 Finish: Concrete paving to have a 'herringbone classic rectangular paver' (100mm x 200mm brick size or approved equal) stamped finish. Type 1 finished concrete to be coloured medium-light grey, via. Admixture. Colour design based on Lafarge 'Antique' Artevia colour blend. Prepare sample in accordance with submittals section above.

.2 Type 2 Finish: Concrete paving to have a medium broom finish to provide no-skid texture running perpendicular to the path of travel. Hand trowel edges. Immediately after floating concrete, give concrete paving surface uniform brush finish and troweled edge, to produce regular corrucations note exceeding 2mm deep, by drawing broom in direction normal to centre line.

.4 Concrete paving exposed surface to a smooth, uniform finish, free of open texturing and exposed aggregate. Do not work more mortar to the surface that required. Do not use neat cement as a dryer to facilitate finishing.

.5 Cure and protect concrete in accordance with CAN3-A23.1.

3.5 TOLERANCES

.1 Concrete Paving: finish surfaces to within 3mm in 3m as measured with 3m straightedge placed on surface.

3.6 EXPANSION AND CONTRACTION JOINTS

.1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, in a grid pattern at intervals of 1.5 m.

.2 Install expansion joints in a grid pattern at intervals of 6 m.

.3 Contractor to lay out expansion and contraction joints prior to respective installation for consultant review.

.4 Install expansion joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, permanent structures and equipment and between different types of concrete.

.5 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

.6 Install joint filler in all expansion joints as indicated in Section 03 30 00 - Cast-in-Place Concrete.

3.7 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, adjacent hard surfacing, catch basins, buildings, or permanent structures.

3.8 CURING

.1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1, to exposed finished surfaces for at least 1 day after placing.

.2 Where polyethylene sheets are used for moist curing, place polyethylene over sufficiently hardened concrete to prevent drainage. Overlap adjacent edges 150 mm and tightly seal with sand or wood planks. Weigh sheets down to maintain close contact with concrete during the entire curing period.

.3 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.

3.9 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material approved by Owner's Representative. Compact and shape to required contours as indicated or as directed by Owner's Representative to ensure a flush transition between softscape areas and concrete paving surfacing.

END OF SECTION

PART 1. General

1.1 DESCRIPTION

.1 This section specifies requirements for the fabrication, supply and installation of site furnishings.

1.2 RELATED SECTIONS

.1 Conform to the requirements of Division 1.
.2 Section 03 16 00 Concrete Paving.

1.3 DELIVERY AND STORAGE

.1 Store units in a protected location immediately upon arrival on site.
.2 Remove from site any units that have been damaged during transportation or storage and replace.

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Shop Drawings.

.2 Submit shop drawings, product data, colour, dimensions and finish samples for all items.

.1 Signs: Submit shop drawings, artwork mock-ups, product data, colour and finish samples for each sign, including foundation design, stamped by a structural engineer licensed in the province of Ontario.

.3 Submit maintenance and operations manual in accordance with item 1.5.1.

1.5 MAINTENANCE DATA

.1 Provide maintenance data for the care, cleaning and operation of site furnishings incorporated into a maintenance and operations manual.

1.6 WARRANTY

.1 Provide a written warranty for the site furnishings and signage components for the duration of project warranty, issued to the Owner against any manufacturer defects, mechanical, structural, operational or aesthetic failures.

1.7 PROTECTION AFTER COMPLETION

.1 Protect site furnishings until acceptance of project work.
.2 Immediately remove from site any damaged furnishings and accessories. Replace, repair, refinish or otherwise make good to the approval of Consultant.

1.8 TESTING, TRAINING AND DEMONSTRATIONS

.1 Digital/LCD components of signs to include one commissioning and training session at a time agreed on between consultant(s), client(s) and manufacturer. Commissioning and training session to include:
  .1 Maintenance requirements and procedures.
  .2 Programming and updating of digital/LCD sign content.

PART 2. Products

2.1 BENCHES

.1 Manufacturer: Victor Stanley
.2 Model: C10
.3 Finish: Metal to be black powdercoated.
.4 Wood: Ipe or approved alternative.
.5 Fasteners: All fasteners to be min. 304 stainless steel. Fasten with tamper-proof bolts or approved alternative.
.6 Footing: Set bench level and attach to cast-in-place concrete paving with surface mount in accordance with contract drawings and manufacturer recommendations.
.7 Locations: In accordance with contract drawings.
.8 Quantities: In accordance with contract drawings.

2.2 BICYCLE RINGS

.1 Manufacturer: Victor Stanley
.2 Model: BRBS 104
.3 Finish: Black powder coated
.4 Fasteners: All fasteners to be min. 304 stainless steel. Fasten with tamper-proof bolts.
.5 Installation: Surface mount on CIP concrete paving per manufacturer instructions.
.6 Locations: In accordance with contract drawings.
.7 Quantities: In accordance with contract drawings.

2.3 BOLLARDS

.1 Manufacturer: Victor Stanley
.2 Model: BKR-36 Complete with chain slots.
.3 Finish: Standard Black Powder Coated
.4 Installation: Surface mount on CIP concrete paving per manufacturer instructions.
.5 Fasteners: All fasteners to be min. 304 stainless steel. Fasten with tamper-proof bolts or approved alternative.
.6 Contractor to supply & install separately: 2” dia. chain, outdoor rated, black colour, uv-resistant no. 8 plastic. Length as required to span between two bollards with 30% dip. Chain to be installed in a manner to where it is easily removable with option to remove only from one end allowing a vehicle to pass through, or complete removal for seasonal storage.
.7 Locations: In accordance with contract drawings.
.8 Quantities: In accordance with contract drawings.

2.4 PEDESTRIAN WAYFINDING SIGNS

.1 Manufacturer: Steel Art Signs Corp. or approved equal.
.2 Materials: Graphic embedded powder coating on an aluminum substrate.
.3 Colours: Dark gray background with white lettering (to be confirmed via. Artwork mock-ups provided by manufacturer).
.4 Dimensions: per contract drawings/details.
.5 Fasteners: All fasteners to be minimum 304 stainless steel. Fasten with concealed tamper-proof bolts or approved equal.
.6 Footing: engineer-stamped footing design to be provided via. Shop drawing submittal by manufacturer.
.7 Artwork & full set of signage shop drawings to be prepared & submitted by manufacturer.
.8 Locations: In accordance with contract drawings, to be laid out on site by installer and confirmed by consultant & client prior to install.
.9 Quantities: In accordance with contract drawings

2.5 SECONDARY VEHICULAR WAYFINDING SIGN

.1 Manufacturer: Steel Art Signs Corp. or approved equal.
.2 Materials: Graphic embedded powder coating on an aluminum substrate.
.3 Colours: Dark gray background with white lettering (to be confirmed via. Artwork mock-ups provided by manufacturer).
.4 Dimensions: per contract drawings/details.
.5 Fasteners: All fasteners to be minimum 304 stainless steel. Fasten to existing wall with concealed tamper-proof fasteners or approved equal.
.6 Artwork & full set of signage shop drawings to be prepared & submitted by manufacturer.
.7 Location: In accordance with contract drawings, to be confirmed on site by consultant & client prior to install.

2.6 MAIN ENTRANCE SIGN

.1 Manufacturer: Steel Art Signs Corp. or approved equal.
.2 Materials: Graphic embedded powder coating on an aluminum substrate. LCD High-resolution outdoor-rated (TV) screen.
.3 Colours: Dark gray background with white lettering (to be confirmed via. Artwork mock-ups provided by manufacturer).
.4 Dimensions: per contract drawings/details.
.5 Fasteners: All fasteners to be minimum 304 stainless steel.
.6 Footings: engineer-stamped footing design to be provided via. Shop drawing submittal by manufacturer.
.7 Artwork & full set of signage shop drawings to be prepared & submitted by manufacturer.
.8 Location: In accordance with contract drawings, to be laid out by installer and confirmed on site by consultant & client prior to install.

PART 3. Execution

3.1 INSTALLATION

.1 Assemble site furnishings in accordance with manufacturer's instructions.
.2 Install furnishings true, plumb, anchored firmly supported as indicated by manufacturer instructions and as directed by consultant.
.3 Touch up shop-applied finishes after installation.
.4 Grease bolts to protect from elements and rusting.
.5 Do not over-tighten bolts to where finish is damaged.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 31 22 13 - Rough Grading

1.2 MEASUREMENT FOR PAYMENT

.1 Preparation of existing grade and placing of topsoil will be measured as specified in the contract unit price schedule based on specified depths installed. Testing for soil quality is included as part of the base price for topsoil placement.

.2 Supply and application of unique soil amendments, excluding fertilizer, will be measured as specified in the contract unit price schedule based on specified quantity installed.

.3 Fine grading will be measured as specified in the unit price schedule.

1.3 DEFINITION

.1 COMPOST: A mixture of soil and decomposing organic matter used as a fertilizer, mulch, or soil conditioner. Compost is processed organic matter containing 40% or more organic matter as determined by the Walkley-Black or LOI test. Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below 25), and contain no toxic or growth inhibiting contaminates. Composed bio-solids must meet the requirements of the Guidelines for Compost Quality, Category 'A' produced by the Canadian Council of the Ministers of the Environment (CCME), January 1996.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 35 43 – Environmental Protection

.2 Divert unused soil amendments from landfill to official hazardous material collections site approved by the Contract Administrator.

.3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 Products

2.1 TOPSOIL QUALITY

.1 Mixture of particulates, microorganisms and organic matter that provides suitable medium for supporting intended plant growth.

.1 Topsoil to be a fertile, friable, natural loam containing not less than 4% organic matter for clay loams and not less than 2% organic matter for sandy loams to a maximum of 15% and capable of sustaining vigorous plant growth, free of subsoil contamination, roots, weeds and stones over 25mm diameter; and having a pH ranging from 6.0 to 7.5.

.2 Contain no toxic elements or growth inhibiting materials.

.3 Contain no seed of invasive species.

.4 Topsoil Consistency: friable when moist

.5 All topsoil imported for this project shall be screened through a 25mm size screen and ensure that it is free from:

.1 Debris and stones over 25 mm diameter.
.2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

2.2 QUALITY CONTROL

.1 The Contractor, at their expense, shall test the topsoil for Nitrogen, Phosphate, Potassium, Potash and minor element values, gradations, clay, silt, soluble salt contents, organic matter, atrazine and pH value in order to determine the amount and type of fertilizer or additives to be applied for specific areas.

.2 Obtain approval of testing agency from the Client. Soil sampling, testing and analysis to be in accordance with Provincial standards.

.3 Conduct topsoil tests on imported topsoil.

.4 Test samples shall be an amalgamation of at least three samples randomly taken from the source. Samples shall be carefully mixed, recorded, labelled and otherwise documented prior to delivery to the testing laboratory

.5 Submit two (2) copies of the topsoil test reports to the Client for approval.

.6 Amend topsoil as per the topsoil test report.

.7 Obtain approval of soil amendments and screening from the Client prior to placement.

PART 3 Execution

3.1 PREPARATION OF EXISTING GRADE

.1 Allow for minor adjustment to rough grade, eliminating uneven areas and low spots to ensure positive drainage.

.2 Remove debris, roots, branches, stones in excess of 25 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products if it was contaminated from the time of rough grading acceptance. Remove debris, which protrudes more than 75mm above surface. Dispose of removed material off site.

.3 Cultivate entire area which is to receive topsoil to minimum depth of 150mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

.4 Place filter fabric over catch basins and manholes to prevent clogging with sediment during the spreading of topsoil and fine grading operations.

3.2 FINISH GRADING

.1 Obtain approval from Client of rough grading before commencing finish grading in accordance with Section 31 22 13 – Rough Grading.

.2 Stockpiled topsoil obtained from site excavations may be reused. Stockpiled topsoil to be made free of stones and debris greater than 25mm via. screening and/or mechanized stone picker.

.3 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

.4 Leave surfaces smooth, uniform and firm against deep foot printing

.5 Spread topsoil in uniform layers not exceeding 150mm settled depth.

.6 Place required depth of topsoil for planting beds as indicated on details.

.7 Place minimum 300mm settled depth of topsoil for seeded and 200mm settled depth for sodded areas.

.8 For sodded areas, keep topsoil 15mm below finished grade.

.9 Manually spread topsoil around trees, shrubs and obstacles.

3.3 Acceptance

.1 Obtain approval of finish grading from the Contract Administrator.

3.4 Surplus Material

.1 Dispose of excess topsoil off site.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 32 91 19.13 - Topsoil and Fine Grading

1.2 MEASUREMENT FOR PAYMENT

.1 Measurement of payment for the supply and installation of sod will be made in square meters as specified in the Form of Tender.

1.3 SOURCE QUALITY CONTROL

.1 Obtain approval from Contract Administrator of sod at source.

.2 When proposed source of sod is approved, use no other source without written authorization.

1.4 SCHEDULING

.1 Schedule delivery and sod laying to follow shortly after finish grading.

.2 Schedule sod installation when frost is not present in ground.

.3 Schedule sod installation outside of periods of drought and summer heat.

.4 Recommended sod installation timing is within the windows of May 1st through June 15 and September 15 through October 31st.

PART 2 Products

2.1 MATERIALS

.1 Number One Turfgrass Nursery Sod: Sod that has been especially sown and cultivated in nursery fields as turfgrass crop.

.1 Turfgrass Nursery Sod Type:

.1 Number one Kentucky Bluegrass/Fescue Sod: sod grown from maximum 40% Kentucky Bluegrass, 30% creeping Red Fescue.

.2 Turfgrass Nursery Sod Quality:

.1 Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres.

.2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
.3 Mowing height limit: 35 to 65 mm.
.4 Soil portion of sod: 6 to 15 mm in thickness.
.5 Sod grown in heavy clay soils will not be accepted. (Minimum 50% Sand, Maximum 6% Clay).
.6 Broken, dry, discoloured pieces will be rejected by Contract Administrator or Client.

.2 Sod establishment support:
.1 Wooden pegs: 17 x 8 x 200 mm.
.2 Biodegradable starch pegs: 17 x 8 x 200 mm.

.3 Water:
.1 Potable water.

.4 Fertilizer:
.1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
.2 Complete, synthetic, slow release with 35 % of nitrogen content in water-insoluble form. Fertilizer with a minimum 90 day, maximum 120 day release schedule. Maximum SGN of 250, minimum 50% PCSCU.

2.2 SOURCE QUALITY CONTROL

.1 Obtain approval from Contract Administrator of sod source.

.2 When proposed source of sod is approved, use no other source without written authorization.

PART 3 Execution

3.1 PREPARATION

.1 Obtain approval of finish grading from the Contract Administrator or Client prior to sod installation.

.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.

.3 Remove and dispose of weeds; debris; stones 25 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials off site.

3.2 DELIVERY AND STORAGE

.1 Deliver, unload and store sod on pallets.

.2 Deliver sod to site within 24 hours of being lifted.

.3 Do not deliver small, irregular or broken pieces of sod.

.4 During wet weather allow sod to dry sufficiently to prevent tearing during lifting and handling.

.5 During dry weather, protect sod from drying out and water sod as necessary to ensure its vitality and prevent dropping of soil in handling. Dry sod will be rejected.

3.3 SOD PLACEMENT

.1 Lay sod within 24 hours of being lifted.

.2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements. All sod boundaries to be full-width rolls, wherever possible.

.3 Roll sod to provide close contact between sod and soil.

.4 The use of heavy roller to correct irregularities in grade is not permitted.

.5 Water sod no more than 6 mm per hour, beginning no later than 30 minutes after installation.

3.4 SOD PLACEMENT ON SLOPES & SWALES AND PEGGING

.1 Start laying sod at bottom of slopes.

.2 Lay sod sections longitudinally along contours of slopes.

.3 All swales to be sodded.

.4 Peg sod on slopes steeper than 3 horizontal to 1 vertical, and drainage channels to following pattern:

.1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
.2 Not less than 4 pegs per square metre.
.3 Not less than 6 pegs per square metre in drainage channels. Adjust pattern as directed by the Client.
.4 Drive pegs to 50 mm above soil surface of sod sections.

3.5 FERTILIZING PROGRAM

.1 Apply fertilizer uniformly at 0.5 kg N/ha before sodding. 1-2-1 ratio.

3.6.1 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of installation.

.2 Water sodded areas no more than 6 mm per hour to depth of 75 to 100mm. Watering should be daily for days 1-7 and every other day for day 8-14 to maintain optimum soil moisture condition until Substantial Performance.

.3 Cut grass, as many times as required , BUT NOT LESS THAN TWO (2) TIMES until Substantial Performance, to 60mm when or prior to it reaching height of 85mm. Remove clippings which will smother grassed areas as. Grass shall not be cut no sooner than 7 days after installation.

.4 Maintain sodded areas 95% weed free via mechanical removal.

3.7 ACCEPTANCE

.1 Turfgrass Nursery Sod areas will be accepted by the Contract Administrator or Client at Substantial Performance provided that:

.1 Sodded areas are properly installed.
.2 Sod is free of bare and dead spots and without weeds.
.3 No surface soil is visible when grass has been cut to height of 60mm.
.4 Sodded areas have been cut a MINIMUM OF TWO (2) TIMES after sod has knit, approximately 4 weeks after sod laying.
.5 Sodded areas have been fertilized. (Contract Administrator or Client is to be notified 24 hrs in advance by the contractor of when the fertilizer application is to be applied.)

.2 Areas sodded in fall will be accepted the following spring one month after start of growing season, provided acceptance conditions are fulfilled.

.3 Remove wooden sod pegs from knitted grass areas.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 31 22 13 - Rough Grading
.2 Section 32 91 19.13 - Topsoil Placement and Grading

1.2 MEASUREMENT FOR PAYMENT

.1 Measurement for payment will be as noted in the pricing summary including all planting soil medium, mulch, geotextile, hardware and incidental items required to complete the installation.

1.3 REFERENCES

.1 Canadian Nursery Landscape Association (CNLA) – Canadian Standards for Nursery Stock - 8th Edition.
.2 International Society of Arboriculture (ISA) – Ontario Chapter.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide product data for:
  .1 Fertilizer.
  .2 Mulch.
  .3 Guying assembly including clamps, collar, guying wire, anchors and wire tightener.

1.5 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide samples for:
  .1 Mulch.
  .2 Planting medium.
  .3 Landscape fabric.

1.6 STORAGE AND PROTECTION

.1 Protect plant material from frost, excessive heat, wind and sun during delivery.

.2 Immediately store and protect plant material which will not be installed within 1 hour after arrival in an approved site storage location.

.3 Protect plant material from damage during transportation:
- .1 When delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.
- .2 When delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
- .3 Protect foliage and root balls using tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.

.4 Protect stored plant material from frost, wind and sun and as follows:
- .1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in sand or topsoil and watering to full depth of root zone.
- .2 For pots and containers, maintain moisture level in containers. Heel-in fibre pots.
- .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.

1.7 SCHEDULING

.1 Schedule of planting program to include:
- .1 Date for selection of specified plant material at source.
- .2 Quantity and type of plant material.
- .3 Shipping dates.
- .4 Arrival dates on site.
- .5 Planting dates.

.2 Obtain approval of planting program schedule from the Contract Administrator 7 days prior to shipment of plant material.

1.8 WARRANTY PERIOD

.1 The Contractor shall warrant all plants for TWO (2) FULL GROWING SEASONS from date of Substantial Performance.

.2 The Client reserves the right to inspect all plant material any time during the warranty period and require replacements at that time, at the sole discretion of the Client/Contract Administrator.

.3 At the end of warranty, the Contractor shall:
- .1 Remove all tree stakes and guys
- .2 Remove and replace all dead plant material, as required by the Contract Administrator, when seasonal conditions are likely to ensure survival and make replacements in the same manner as specified for the original plants.

.3 Remove trunk protection.

.4 Plant material replacements that occur during the warranty period will require extended warranties equal to the original warranty period. Extended warranty period will commence when the Contract Administrator has accepted the plant material replacements.

PART 2 Products

2.1 PLANTING SOIL MEDIUM

.1 Use imported topsoil as follows
- .1 6 parts imported topsoil, 2 parts well rotted weed-free manure, 1 part peat moss.
- .2 Screened through a 25mm size screen.

.2 Install Triple Mix

2.2 PLANT MATERIAL

.1 Plant material to conform to the applicable details and as listed in the “Plant List” on drawings.

.2 Substitutions for specified plants require the Contract Administrator’s written approval prior to delivery.

.3 Type of root preparation, sizing, grading and quality: comply with the Canadian Standards for Nursery Stock, Latest Edition, published by the Canadian Nursery Landscape Association.

- .1 Source of plant material: grown in Zone 5 in accordance with Agriculture Canada Plant Hardiness Zone Map.

.4 Plant material: free of disease, insects, defects or injuries and structurally sound with strong fibrous root system.

.5 Trees: with straight trunks, well and characteristically branched for species except where specified otherwise.

.6 Plant material: root pruned regularly, but not later than one growing season prior to arrival on site.

.7 No preservative treated (green) burlap is acceptable on any balled and burlapped deciduous or coniferous plant materials. The Contract Administrator reserves the right to reject any plant materials on-site with preservative treated burlap.

2.3 **WATER**

.1 Potable water.

2.4 **ACCESSORIES**

.1 Wood stakes, biodegradable tree ties, arborguard + tree guard, welded wire beaver protection, mulch.

2.5 **TRUNK PROTECTION**

.1 Arborguard + Tree Guard or approved equal.

.2 Welded wire mesh cylindrical beaver protection surrounding trunks. See applicable tree planting detail.

- Bottom of beaver guard to meet flush with rootball. Check and adjust guards every fall to ensure they are free of gaps, trash and not interfering with root or trunk development.

2.7 **MULCH**

.1 Shredded pine bark: varying in size from 25 to 75 mm in length. 100mm depth.

2.8 **FERTILIZER**

.1 Synthetic commercial type as recommended by soil test report/manufacturer

2.9 **PEATMOSS**

.1 Derived from partially decomposed species of Sphagnum Mosses.

.2 Elastic and homogeneous, brown in colour.

.3 Free of wood and deleterious material which could prohibit growth

.4 Shredded particle minimum size: 5 mm.

2.10 **LANDSCAPE FABRIC**

.1 In accordance with Section 31 32 19.01 – Geotextiles.

2.11 **SOURCE QUALITY CONTROL**

.1 Obtain approval from Contract Administrator of plant material prior to delivery to the site prior to planting.

.2 Plant material must be from local sources within 100km of site.

PART 3 Execution

3.1 PRE - PLANTING OPERATIONS

.1 Ensure plant material on site is acceptable to Contract Administrator.

.2 Deliver all materials in their original containers with all labels intact and legible. Containers with additives shall clearly indicate contents, weight, analysis and manufacturer's name.

.3 Prune damaged roots and branches from plant material.

3.2 EXCAVATION AND PREPARATION OF PLANTING BEDS

.1 Stake out location of tree pits and shrub beds and obtain approval from the Contract Administrator prior to excavating.

.2 Establish sub-grade and prepare planting beds as specified.

.3 Excavate to depth and width as per applicable detail.

.4 Remove rocks, roots, debris and toxic material from material that will be used as planting soil for trees and individual shrubs. Dispose of excess material as directed by Contract Administrator.

.5 Scarify sides and bottom of tree pits and shrub beds.

.6 Remove water which enters planting pits and beds prior to planting. Notify Contract Administrator if water source is ground water.

3.3 PLANTING

.1 For jute burlapped root balls, cut away top a minimum of one third of wrapping and wire basket without damaging root ball. Do not pull burlap or rope from under root ball.

.2 For container stock or root balls in non-degradable wrapping, remove entire container or wrapping without damaging root ball.

.3 Plant vertically in locations as indicated. Orient plant material to give best appearance as directed by Contract Administrator in relation to structure, roads and walks.

.4 For trees :

.1 Backfill soil in 150 mm lifts. Tamp each lift to eliminate air pockets. When two thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, backfill to finish grade.

.2 Form watering saucer as per applicable detail.
.3 Trunk protection and filter cloth shall be installed on all trees planted within a naturalized/no-mow zone.

.5 For shrubs:

.1 Backfill soil evenly to finish grade and tamp to eliminate air pockets.

.2 Install filter fabric over entire planting bed and cut slits to accommodate shrub root balls prior to mulching.

.6 For ground covers and herbaceous plant material:

.1 Backfill soil evenly to finish grade and tamp to eliminate air pockets.

.7 Install all trees 50-75mm high relative to finish grades to allow for natural settlement.

.8 Water plant material thoroughly.

.9 Dispose of burlap, wire and container material off site.

3.4 INSTALLATION OF ACCESSORIES AND TRUNK PROTECTION

.1 Install tree supports, accessories, and trunk protection as per applicable detail.

.2 Install trunk protection prior to installation of tree supports when used.

.3 After tree supports have been installed, remove broken branches with clean, sharp tools in accordance with horticultural best-practices for tree pruning.

3.5 MULCHING

.1 Ensure soil settlement has been corrected prior to mulching.
.2 Spread mulch as per applicable detail.

3.6 PRUNING

.1 Prune all plants to remove dead and broken branches.

.2 Preserve the natural character of the plant and do not remove leader.

.3 Use clean, sharp tools and make cuts clean and flush without leaving stubs.

.4 Cut back to living tissue all cuts, scars and bruises and shape so as not to retain water.

3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following maintenance operations from time of planting to Substantial Performance:

.1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.

.2 For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.

.3 Remove weeds monthly.

.4 Replace or respread damaged, missing or disturbed mulch.

.5 For non-mulched areas, cultivate as required to keep top layer of soil friable.

.6 Remove dead or broken branches from plant material.

.7 Keep trunk protection and guy wires in proper repair and adjustment.

.8 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plants.

3.8 ACCEPTANCE

.1 All plant material will be accepted by the Contract Administrator after the entire project has received Substantial Performance and the planting operation is completed, if in the sole discretion of the Contract Administrator, the plant material exhibits healthy vigorous growth and is free from disease, insects and fungal organisms.

.2 All Plant material installed less than 90 days prior to frost will be accepted in following spring, 30 days after the start of the growing season provided that acceptance conditions are fulfilled.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Labour, Products, equipment and services necessary for foundation drainage Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 ASTM C4 - Clay Drain Tile and Perforated Clay Drain Tile.

.2 ASTM C412/C412M - Concrete Drain Tile.

.3 ASTM D2729 - Poly (VinylChloride) (PVC) Sewer Pipe and Fittings.

1.3 SUBMITTALS FOR REVIEW

.1 Section 01300: Submission procedures.

.2 Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts and gradient of slope between corners and intersections.

.3 Product Data: Provide data on pipe drainage products and pipe accessories

1.4 SUBMITTALS FOR INFORMATION

.1 Section 01 33 00: Submission procedures.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 01 33 00: Submission procedures.

.2 Record location of pipe runs, connections, cleanouts and principal invert elevations.

PART 2 Products

2.1 MATERIAL

.1 Perimeter drainage

.1 ASTM D3350 and ASTM F667, 100 mm diameter HDPE, perforated with fittings prewrapped with filter cloth by Ideal Pipe or approved alternative or 'TREMDrain Total Drain' by Tremco Inc.

.2 Perimeter drainage system to be complete with accessories as required for complete installation including but not limited to corner guard pieces and outlet pipe connections.

.2 Drainage board:

.1 Three-dimensional dimpled core and geotextile fabric complete with adhesive or fasteners as required for installation. Sika Drainage Mat 420/720.

.3 Drainage pipe: ASTM D3350 and ASTM F667, 100 mm diameter HDPE by Ideal Pipe or approved alternative, unperforated with fittings, and perforated with fittings prewrapped with filter cloth in locations as indicated on drawings or as specified herein.

.4 Clean outs: 100 mm HDPE outlets , tees, extension pipes, reducers, flush plugs, etc. suitable for use with drainage pipe as manufactured by Canron Inc, Ideal Pipe, or approved alterative.

.5 Foundation drainage Pipe Fill: 19 mm clear stone in accordance with OPSS 1004.

.6 Granular fill: Free draining, sharp, hard, durable, granular material conforming to OPSS 1010, Type A.

.7 Filter cloth: Terrafix 270R as manufactured by Terrafix Geosynthetics Inc. or approved equivalent.

PART 3 Execution

3.1 EXAMINATION

.1 Verify that [trench cut] [excavated base] is ready to receive work and excavations, dimensions, and elevations are as indicated on [layout] Drawings.

3.2 PREPARATION

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and any other foreign matter detrimental to installation.

3.3 INSTALLATION

.1 Install perimeter drainage around perimeter of foundation and where indicated on Drawings.

.2 Install drainage board in accordance with ASTM F449 and manufacturer's recommendations. Drainage board shall extend full height of foundation wall to top of footing where indicated on Drawings. Install drainage board after installation of waterproofing membrane is complete. Position panel with flat side against wall and filter fabric toward soil/drainage side and attach to foundation wall using manufacturer approved fastening system.

.3 Provide unperforated drainage pipe between perforated drainage pipe and drain connection installed by Division 15.

.4 Install drainage pipe on a bed of foundation drainage fill, minimum 100 mm deep where pipe is not placed over footing, and surround with same fill 150 mm thick at sides and over top of pipe and for under floor drainage extend fill to under side of slab.

.5 Provide cleanouts on non-perforated pipe at all changes of direction and in pipe runs greater than 15 metres. Provide flush cleanouts where indicated.

.6 Cover foundation drainage fill with filter cloth. Cover filter cloth with sand 300 mm thick at top and sides.

3.4 FIELD QUALITY ONTROL

.1 Section 01400: Field inspection and testing.

.2 Request inspection prior to and immediately after lacing aggregate cover over pipe.

3.5 PROTECTION

.1 Section 01500: Protect finished installation.

.2 Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

Appendix A:

Designation ByLaw (124-76) for 285 Spadina Road.
Spadina National Historic Site designation, July 2019.

ONTARIO HERITAGE TRUST

An agency of the Government of Ontario

FIDUCIE DU PATRIMOINE ONTARIEN

Un organisme du gouvernement de l'Ontario

This document was retrieved from the Ontario Heritage Act e-Register, which is accessible through the website of the Ontario Heritage Trust at **www.heritagetrust.on.ca.**

Ce document est tiré du registre électronique. tenu aux fins de la *Loi sur le patrimoine de l'Ontario,* accessible à partir du site Web de la Fiducie du patrimoine ontarien sur **www.heritagetrust.on.ca.**

IN THE MATTER OF THE ONTARIO HERITAGE ACT, 1974, S.O. CHAPTER 122

AND IN THE MATTER OF THE DESIGNATION OF THE PROPERTY KNOWN AS THE AUSTIN HOUSE AT 285 SPADINA ROAD

NOTICE OF PASSING OF BY-LAW

To: [redacted]
285 Spadina Road,
Toronto, Ontario,
M5R 2V5.

✓Ontario Heritage Foundation.

Take notice that the Council of The Corporation of the City of Toronto has passed By-law No. 124-76 to designate the above property. (File 0946).

DATED at Toronto this 21st day of May, 1976.

Roy V. Henderson

ROY V. HENDERSON
City Clerk.

No. 124—76. A BY-LAW

To designate the Austin House at 285 Spadina Road of architectural value.

[Passed March 31, 1976.]

Whereas The Ontario Heritage Act, 1974, authorizes the council of a municipality to enact by-laws to designate real property, including all the buildings and structures thereon, to be of historic value or interest; and

Whereas the Council of The Corporation of the City of Toronto has caused to be served upon the owner of the lands and premises known as the Austin House at 285 Spadina Road and upon the Ontario Heritage Foundation notice of intention to so designate the aforesaid real property and has caused such notice of intention to be published in a newspaper having a general circulation in the municipality once for each of three consecutive weeks; and

Whereas the reasons for the designation are set out as Schedule 'B' hereto; and

Whereas no notice of objection to the said property designation has been served upon the clerk of the municipality;

Therefore, the Council of The Corporation of the City of Toronto enacts as follows:

1. There is designated as being of architectural value or interest the real property, more particularly described in Schedule 'A' hereto, known as the Austin House at 285 Spadina Road.

2. The City Solicitor is hereby authorized to cause a copy of this by-law to be registered against the property described in Schedule 'A' hereto in the proper land registry office.

3. The City Clerk is hereby authorized to cause a copy of this by-law to be served upon the owner of the aforesaid property and upon the Ontario Heritage Foundation and to cause notice of this by-law to be published in a newspaper having general circulation in the City of Toronto.

DAVID CROMBIE,
Mayor.

ROY V. HENDERSON,
City Clerk.

COUNCIL CHAMBER,
Toronto, March 31, 1976.
(L.S.)

SCHEDULE "A"

All and singular that certain parcel or tract of land and premises situate, lying and being in the City of Toronto, in the Municipality of Metropolitan Toronto, formerly in the County of York and Province of Ontario, being composed of part of Township Lot 24 in the Second Concession from the Bay in the Original Township of York, but now in the said City of Toronto, the boundaries of the said parcel being described as follows: Commencing at the intersection of the easterly limit of Spadina Road with the northerly limit of Davenport Road; Thence northerly along the said easterly limit of Spadina Road 805.00 feet more or less to the line of an old board fence running easterly therefrom; Thence easterly along the said line of old board fence, being along the southerly limit of the westerly part of the lands included in a plan registered in the Registry Office for the Registry Division of Toronto as E711, a distance of 313.81 feet more or less to the line of another old board fence running southerly therefrom; Thence southerly along the last-mentioned line of old board fence, being along the westerly limit of the southerly part of the lands included in the said plan E711 and along the westerly limit of the lands included in a plan registered in the said Registry Office for Toronto as 766-E, in all a distance of 780.00 feet more or less to the aforesaid northerly limit of Davenport Road; Thence westerly along the last-mentioned limit 316.48 feet more or less to the point of commencement.

SCHEDULE "B"

Reasons for the designation of The Austin House —
285 Spadina Road at Austin Terrace (NE)

The Austin House, begun c. 1866 and added to subsequently, is designated on architectural grounds as being significant architecturally as one of the most important examples of the changing patterns of nineteenth century interior design in the City of Toronto. The interiors range in style from the Rococco Revival of the 1860's and 1870's to the Art Nouveau. The building also includes a porte cochere by the New York firm of Carrere & Hastings. The building and grounds are also important in the context of the area as a complement to Casa Loma and an integral part of the open spaces surrounding that building and extending along the ridge above Davenport Road.

National historic designations

Spadina National Historic Site

Spadina mansion was designated a National Historic Site in July 2019.

Commemorative plaque:

This stately mansion was constructed in 1866 as a Victorian estate and villa for Toronto financier James Austin, a founder and first president of the Dominion Bank. In 1897, his son Albert inherited the property and commissioned extensive renovations, carried out by Toronto architects W. C. Vaux Chadwick and Eustace G. Bird. The well-preserved interiors of Spadina house, with its unique Art Nouveau features, and the expansive surrounding landscape and outbuildings, including the chauffeur's quarters, illustrate the opulent lifestyle of Canada's social elite in the late 19th and early 20th centuries.

Spadina mansion

Begun in 1866 for Toronto entrepreneur James Austin and his wife Susan Bright Austin, this Toronto landmark is a rare example of a country estate and villa transformed into an opulent Edwardian residence. Between 1897 and 1913, Toronto architect W.C. Vaux Chadwick, the American firm Carrère and Hastings with Eustace G. Bird, and painter Gustav Hahn designed extensive changes for the earlier Victorian country house, whose designer is unknown. Spadina was inherited by James Austin's son Albert. Together with his wife, Mary, he commissioned renovations that would impress upon neighbours and visitors alike the family's prominent social position and their wealth. The mansion's architecture, interior design and furnishings together with its surrounding grounds, garden, and outbuildings illustrate the grandeur in which Canada's wealthy elite lived during a period of rapid urban expansion at the beginning of the 20th century. This is conveyed on the interior through the innovative arrangements of public and private rooms for the family and a servants quarters. On the exterior, it is expressed in the design and arrangement of gardens, greenhouse, and a garage complete with chauffeur's quarters.

The current Spadina, a large, architecturally eclectic, 55-room mansion, was preceded on the property by two other, smaller houses built in 1818 and 1836. Both were destroyed by fire and both were also named Spadina. Considerably altered in the last round of renovations in the early-20th century, the house exhibits a predominantly Second Empire aesthetic, with earlier, mid-19th century architectural elements visible on the exterior and interior. Clad in buff brick with dark green trim and a grey mansard

Spadina, Toronto
© Jennifer A. Cousineau, Parks Canada, 2018

roof, the distinctive elements of Spadina include its double-height bay windows, numerous dormers, the balustraded south terrace, and the elaborate iron and glass porte-cochère on its west side. The house is roughly symmetrical about its long, north-south central hallway, but is irregular in the disposition of windows, doorways, and rooms within the plan. Its lively exterior composition reveals a different elevation design on each of the four sides of the house.

The interior of Spadina combines luxurious spaces for private family use and public entertainment with utilitarian spaces once inhabited by staff that ran the household. Many rooms, with their intact collections of original family furniture and art objects, form the core of the house museum; other rooms serve various museological functions including offices, a library, and storage rooms. The basement currently houses a gift shop, meeting room, storage rooms, and exhibition space that exposes the first (1818) Spadina foundations. The first floor contains the historic kitchen, dining room, entry hall, reception room, drawing room, and a conservatory known as the Palm Room. The second floor has historic bedrooms, current staff offices, and sitting rooms. The third floor contains servant spaces – bedrooms, bathroom, and sitting room – as well as historic family bedrooms and sitting rooms.

Spadina sits on a 5.7-acre (2.31 hectare) plot of land on the brow of Davenport Hill in the Casa Loma district of Toronto. The northern part of the property, now separated from the southern part on the west side by a stone pergola dating to 1909, contains the services buildings – stable (1850), garage/chauffeur's residence (1909), and greenhouse (1913). An apple orchard also sits north of the house. To the east is a formally-planned kitchen and flower garden in parterre formation. South of the house, the terrace opens onto a large manicured lawn that culminates in a tree screen at the lip of Davenport Hill.

Backgrounder last update: 202-12-10

The National Program of Historical Commemoration relies on the participation of Canadians in the identification of places, events and persons of national historic significance. Any member of the public can nominate a topic for consideration by the Historic Sites and Monuments Board of Canada.

Get information on how to participate in this process

Related links

- National historic designations
- National historic persons
- National historic sites designations
- National historic events
- Submit a nomination

Date modified :

2022-10-14

Appendix B:

Analysis of Finishes on an Exterior Door at Spadina House Museum, dated October 31, 2016.
Examination and Test Report for Spadina House Museum Exterior Garage Doors, dated December 7, 2016.

REPORT

Analysis of Finishes on an Exterior Door at Spadina House Museum

for

City of Toronto, Museum and Heritage Services
Toronto, Ontario, Canada

Eric J. Henderson and Kate Helwig
Conservation Science Division

October 31, 2016
Report No. CSD 5376, CCI 129442

Canadian Conservation Institute | Institut canadien de conservation

Canada

Introduction

Analysis was undertaken of paint samples from an exterior wooden door at Spadina House Museum, a historically designated property and museum in Toronto, Ontario. The surface of the painted door is covered with a white bloom, and the paint is flaking in numerous areas. The bloom is more pronounced along the top third of the door, which is located beneath an overhang, and there is very little bloom on the inside surface of the door (which appears to have the same finish).[1] The door is presently undergoing conservation treatment aimed at removing the bloom and retaining the original finish. Analysis was requested to identify the material in the bloom, to determine the composition of the top paint layer, and to identify the binder(s) in the lower paint layers. The results of the analysis will inform the treatment of the door.

Methods of Analysis

Two large fragments containing the wood substrate, paint layers, and surface bloom were sent for analysis.

A portion of one of the fragments was mounted as a cross-section in polyester resin, ground and polished using standard petrographic techniques, and observed by incident light and fluorescence microscopy using a Leica DMRX microscope. The cross-section was analyzed by scanning electron microscopy/energy dispersive spectrometry (SEM/EDS) using an Hitachi SU3500 SEM integrated with an Oxford Inca X-act analytical silicon drift x-ray detector and an AZtec x-ray microanalysis system. The cross-section was analyzed at a pressure of 60 Pa and an accelerating voltage of 15 kV using a backscattered electron detector. With this technique, elemental analysis of volumes down to a few cubic micrometers can be obtained for elements from boron (B) to uranium (U) in the periodic table at a level of approximately 0.1–1% or greater.

Individual bloom and paint layers were separated and analyzed by one or more of the following techniques: Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy, and polarized light microscopy (PLM).

For FTIR, the samples were analyzed using a Bruker Hyperion 2000 microscope interfaced to a Tensor 27 spectrometer. Portions of each sample were positioned on a diamond microsample cell and analyzed in transmission mode.

Raman spectra were collected with a Bruker Senterra dispersive Raman microscope. An excitation wavelength of 785 nm was employed, and a 50× objective lens was used to produce an analysis area of approximately 2 micrometers in diameter.

© Government of Canada, Canadian Conservation Institute

This report belongs to the Canadian Conservation Institute (CCI) as per the terms and conditions of your Agreement(s) with CCI. No reproduction in any format or distribution in print or online of this report, in whole or in part, is authorized without prior written approval from CCI. Requests can be submitted by e-mail to PCH.iccservices-cciservices.PCH@canada.ca.

Samples were prepared as dispersions in Cargille Meltmount mounting medium (n=1.66) and examined by PLM using a Leica DMRX polarizing light microscope.

Results and Discussion

The results of the analysis are presented in **Table 1** and are summarized below.

The two fragments have a similar appearance: the topmost surface of paint is densely covered by the whitish bloom, and in several areas the top layers of paint have flaked off revealing an underlying red/brown paint layer (**Figure 1**).

Figure 1: Micrograph of a fragment of paint adhered to the wood substrate. The top layers of paint have flaked off in numerous areas and the top surface is covered with a white bloom.

Paint stratigraphy: The stratigraphy of the sample was determined by preparing a cross-section (**Figure 2**). Five layers of paint can be seen, including (starting from the bottom) a thick dark red bottom layer (1), a thin red layer (2), a yellowish brown layer (3), a dark grey layer (4), and the red-brown top layer (5). The thin whitish bloom (6) can be seen above the top layer of paint. A thin fluorescent layer can also be seen above the yellowish brown paint layer (**Figure 2B**), and is possibly a varnish. The cross-section also shows cracking between layers 1 and 2, which corresponds to the interface where the delamination is occurring.

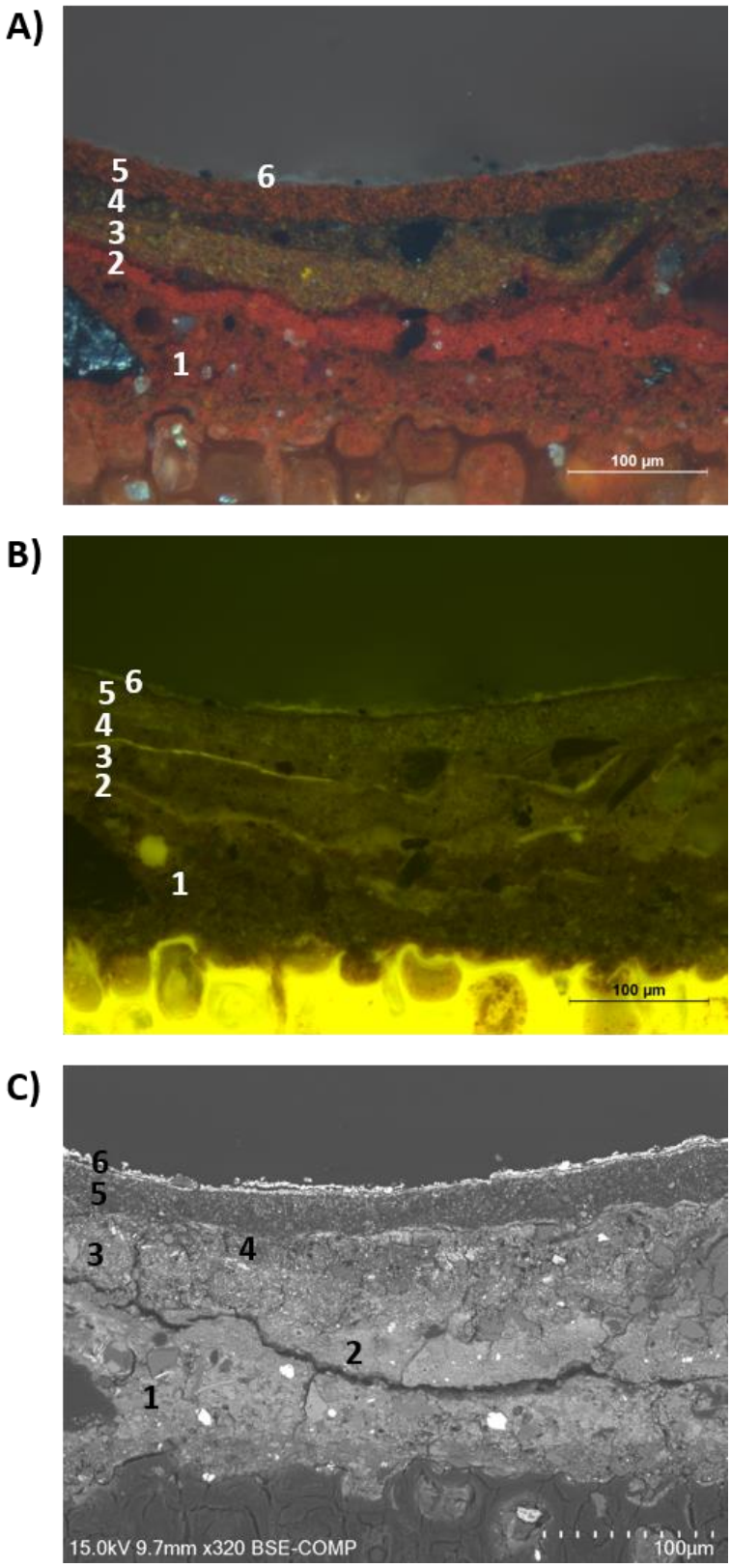


Figure 2: Cross-section of the paint and surface bloom on a wooden substrate. **A)** Incident light, **B)** autofluorescence, **C)** backscattered electron image.

Binding media of the paint layers: The medium of the two upper paint layers (red-brown (5) and dark grey (4)) is an oil-modified *ortho*-phthalate alkyd resin. The yellowish brown paint (3), the thin red paint (2), and the thick dark red paint (1) are all oil-based.

Red-brown paint (layer 5): A detailed analysis was undertaken of the red-brown paint. As described above, the binding medium is an oil-modified *ortho*-phthalate alkyd resin. The pigments and fillers identified are: finely divided red iron oxide, a small amount of black pigment, and lead sulfate. Calcium oxalate was also identified, and may be the result of microbial activity.[2,3]

Surface bloom (layer 6): The white bloom is composed primarily of lead sulfate. Trace amounts of unidentified organic material were detected in the FTIR spectra, but it is not clear if they originated in this layer or were contamination from the underlying paint.

The origin of the lead sulfate on the paint surface is unclear. Lead sulfate is a white pigment, known to have been a common component in architectural finishes.[4,5] In addition to being the primary constituent of the bloom material, it was also identified as a component in the top red-brown paint layer (2). It is possible that the lead sulfate in the bloom originated from this paint layer. Lead sulfate is toxic (especially by inhalation of fine powders),[6] and care should be taken during the treatment of the door.

Table 1: Analytical results

Sample Description	Elements detected*	Components identified**
Layer 6 – surface bloom	**Pb**, **S**, **C**, **O**, Si, Al, Fe, (Ca, K)	• lead sulfate
Layer 5 – red-brown	**C**, O, Pb, S, Al, Si, Fe, (Cl, Zn, Na, Ca)	• alkyd resin (probably oil-modified *ortho*-phthalate type) • lead sulfate • red iron oxide • black pigment (minor) • calcium oxalate
Layer 4 – dark grey	**C**, O, Pb, S, Al, Si, Fe, Ca, Zn, (Ba, Mg, K)	• binder: oil-modified *ortho*-phthalate alkyd resin
Layer 3 – yellowish brown	**C**, **O**, Pb, Si, Al, S, Fe, (Zn, Ca, Ba, Cl, Mg, Cr, K)	• binder: drying oil
Layer 2 – red	**C**, **O**, Pb, Al, Si, Fe, (S, Ca, Cl, Mg, Na, K)	• binder: drying oil
Layer 1 – dark red	**C**, **O**, Pb, Al, Si, Fe, Ca, (Cl, Mg)	• binder: drying oil

*Elements are listed in order of relative peak height in the EDS spectrum as: **major**, minor, (trace).
Al = aluminum, Ba = barium, C = carbon, Ca = calcium, Cl = chlorine, Cr = chromium, Fe = iron, K = potassium, Mg = magnesium, Na = sodium, O = oxygen, Pb = lead, S = sulfur, Si = silicon, Zn = zinc.
**Lead sulfate = $PbSO_4$, calcium oxalate = CaC_2O_4.

Conclusions

Fragments removed from the wooden door of the Spadina House and Museum are composed of five layers of paint. The medium of the two upper paint layers (red-brown and dark grey) is an oil-modified *ortho*-phthalate alkyd resin, while the bottom layers (yellowish brown, red, thick dark red) are oil-based. Flaking of the paint appears to be occurring as a result of delamination between the bottom two layers (red paint and thick dark red paint). The whitish surface bloom is composed primarily of lead sulfate, which possibly originated from the underlying red-brown paint.

References

1. Sandra Lougheed, (Senior Project Co-ordinator, City of Toronto Museum and Heritage Services), personal communication, October 2016.

2. Elizabeth A. Moffatt, Neil T. Adair, and Gregory S. Young, "The Occurrence of Oxalates on Three Chinese Wall Paintings" in : *Application of Science in Examination of Works of Art*, *Proceedings of the Seminar*: 7-9 September 1983, edited by Pamela A. England and Lambertus van Zelst (Boston: Museum of Fine Arts, 1985), pp. 234-238.

3. Salvadori Ornella and Zitelli Andreina, "Monohydrate and Dihydrate Calcium Oxalate in Living Lichen Incrustations Biodeteriorating Marble Columns of the Basilica of Santa Maria Assunta on the Island of Torcello (Venice)," in: *Preprints, The Conservation of Stone II – Part A: Deterioration,* Bologna, Italy, 27-30 October 1981, edited by Raffaella Rossi-Manaresi (Bologna: Centro per la Conservazione delle Sculture All'Aperto, 1981), pp. 379-390.

4. Nicholas Eastaugh, Valentine Walsh, Tracey Chaplin, and Ruth Siddall, *The Pigment Compendium – A Dictionary of Historical Pigments* (Oxford: Elsevier Butterworth-Heinemann, 2004), pp. 230-231.

5. David A. Crown, *The Forensic Examination of Paints and Pigments* (Springfield: Charles C. Thomas, 1968), p. 29.

6. Dodd S. Carr, William C. Spangenberg, Kevin Chronley, and Dayal T. Meshri, "Lead Compounds," in: *Kirk-Othmer Encyclopedia of Chemical Technology – Fifth Edition*, vol. 14, edited by Arza Seidel (Hoboken: John Wiley & Sons, Inc., 2007), pp. 782-804.

Examination and Test Report
Spadina House Museum Exterior Garage Doors

Material(s): painted wood

Location: garage located on the grounds of the Spadina House Museum, 285 Spadina Road, Toronto.

Description: three pairs of large wooden doors with glazed upper halves, dating to approximately the late 19 or early 20th century. The surfaces of the painted doors are covered with a white bloom, varying in density from top to bottom; there are a number of paint layer coatings, with interlayer cleavage occurring throughout. The bloom is more pronounced in the top third of the doors, which are located beneath a deep overhang, too a much minor degree some bloom is observable on the interior sides of the doors. Fragments of the paint with wood substrate were sent to C.C.I. for analysis. C.C.I. analysis involved cross-section, instrumental and microscopical analysis.

Aim: to determine solubility and process for removal of white bloom visible on the surface of the painted doors; white bloom is uneven in distribution and density, in some locations there is no bloom. In addition, a chemical

Photo 1: General view of doors.

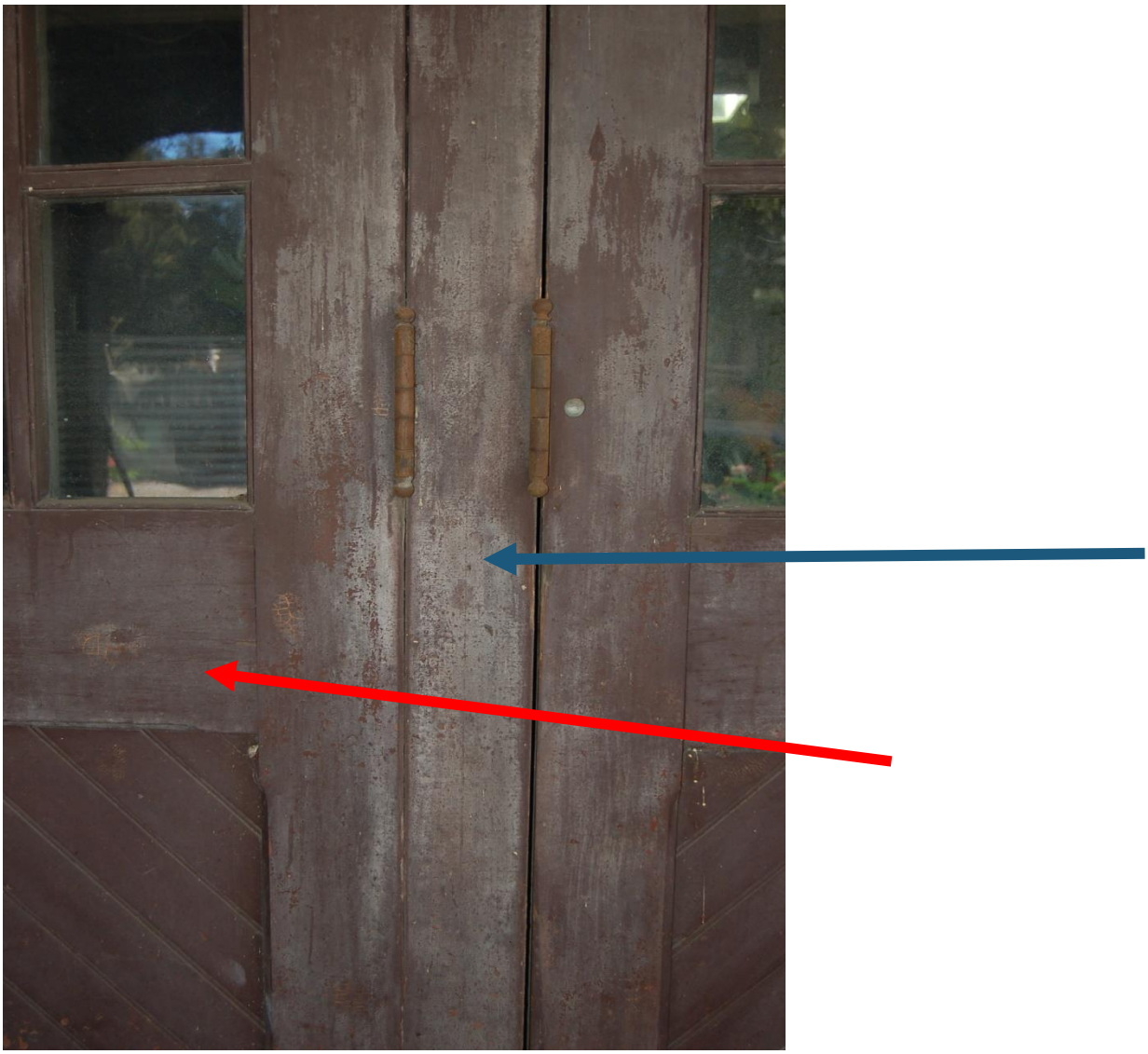


Photo 2: detail of door where testing was undertaken, also shows variation in density of bloom

Condition: The bloom is unevenly distributed over the entire surface of the exterior doors and is much denser along the upper half of the doors. (Photos 1 and 2). It is also present on the inside doors, but much less so. In some locations, it has the makeup of a distinct continuous layer, (blue arrow, photo 2) while in other locations it is very lightly distributed (red arrow, photo 2).

Testing Methods: A series of solvent and mechanical tests were carried out on the bloom covered paint; in addition, two clear coating tests were made with resin to seal/saturate the bloom.

Test location the second door from the left, right side, middle (area visible in photo 2).

TEST RESULTS

	Test Reagent	Observations	Comments
1	**Varsol**	Some mechanical pick-up and slight brown colour on swab	On drying a slight lessening of white haze
2	**Ammonia/water, pH 8**	Mechanical pick-up only	No reduction in bloom
3	**Xylenes**	Same as 1	Same as 2
4	**Acetone**	Mechanical pick-up with some slight colour on swab	Very slight reduction of bloom
5	**Iso propanol**	Same as 4	Minimal reduction
6	**Glycol ether pm**	More marked solubilisation of brown paint, but slow acting	Slight, uneven reduction of bloom
7	**Methylene chloride**	Swells and slowly removes bloom and brown paint	All bloom removed plus brown paint dependent upon working time
8	**Methanol**	Slowly removes bloom, with some brown as well	Same as 7
9	**Ammonium citrate, pH 6**		Uneven reduction of bloom
10	**6% B-72**	Darkens/saturated, bloom still visible	
11	**12% B-72**	Darkens/saturated, bloom still slightly visible	
12	**Mechanical scraping with scalpel**	Interlayer separation: top layer is a cool/purple brown which readily cleaves consistently down to an underlying warmer toned brown. The underlying warmer toned brown appears in better condition and is well bonded to substrate.	Topmost brown layer is very cracked, badly weathered and poorly adhering to underlying coating(s). Mechanical removal appears to clean down to same layer which is in relatively good condition. Blades or thin tapered tools could be used for mechanical process.
13	**Soy Gel Paint Stripper**	Swells and bubbles, slowly, time dependant: the longer stays on the greater degree of swelling , down to base wood	Difficult to control, may be possible with timing to control degree and depth of swelling, but would be laborious and time consuming.

Note: tests 1-9 done with cotton swabs rolled over surface, all tests resulted in mechanical pick-up of fragments of the topmost brown coating. Tests 10, 11, 13 applied with a brush; 13 subsequently rolled with cotton swabs for pick-up of swollen coating(s).

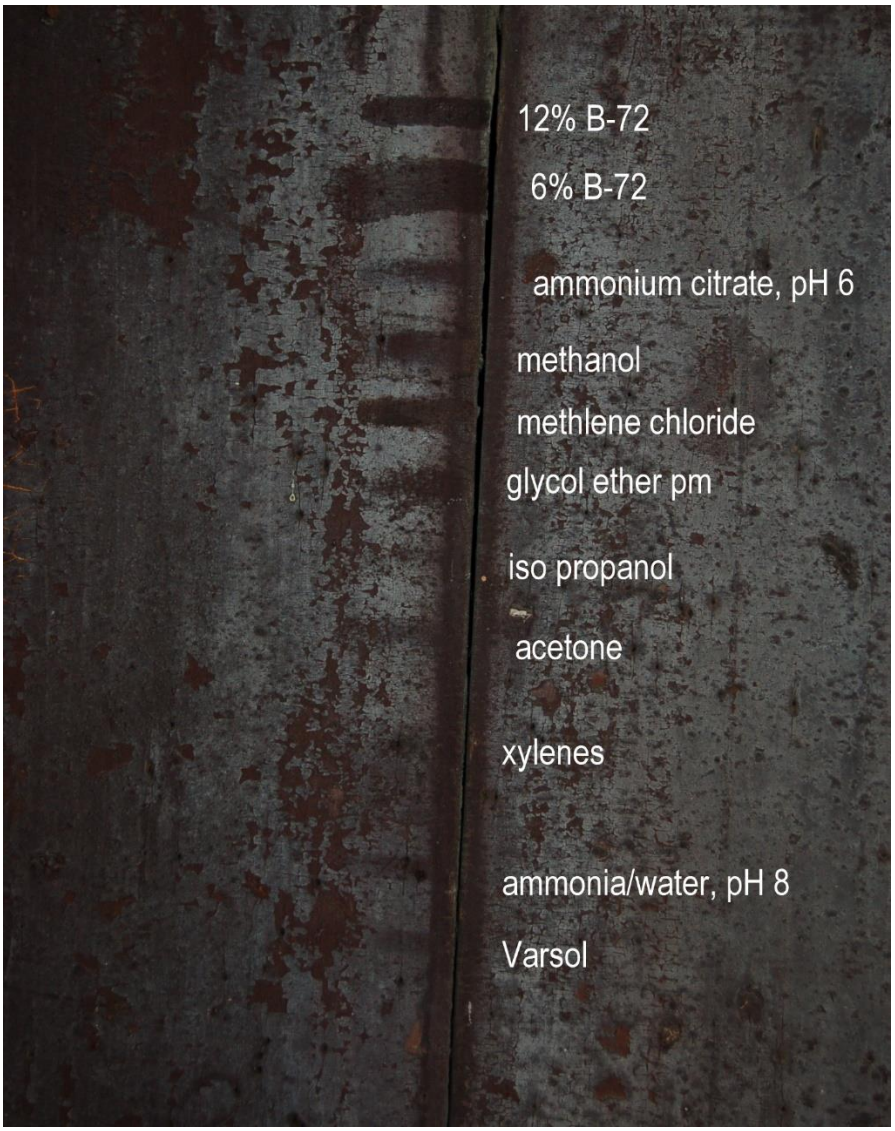


Photo 3: series of tests carried out as outlined in Table

Assessment: no low toxic solvent tested effectively removes the bloom, only much more toxic, and strong solvent power solvents remove the bloom.

Mechanical removal (scrapping with a scalpel or other sharp bladed instrument) is quite effective in consistently removing the thicker topmost coating down to the same consistent underlying coating. The underlying coating appears to be in satisfactory condition and is well bonded to the substrate.

Chemical analysis by C.C.I. * indicates that the white bloom is lead sulphate, which explains the poor solubility of the bloom except in strong solvents. These strong solvents will be difficult to control to maintain a consistent appearance/finish, whereas the mechanical process works consistently quite well.

Recommendations:

1. The bloom and underlying brown paint can be removed mechanically. The process is labour intensive and Health and Safety procedures/protocols would need to be in place, to contain air borne lead dust and ensure the safety of handlers.

2. Less thick layers of bloom could be selectively removed with solvents such as methanol, methylene chloride or solvent gels or emulsions. The appearance of the underlying brown paint may not be uniform in colour, texture or gloss.

3. Removal of the bloom must be carried out by a conservator to help ensure visually even results.

4. Other areas of the brown painted portico should be tested for lead sulphate bloom (see Photo 4).

Photo 4: whitish areas may be lead sulphate as found on doors; needs to be analysed.

5. Because of the poor bond between the topmost brown paint and underlying layers, the alternative of coating/sealing the white bloom (to contain and saturate) may not be practicable as the interlayer cleavage could continue to occur due to uneven penetration of coating/sealant. The result would be uneven texture and colour in appearance of painted surfaces.

Barry Briggs, 7 December, 2016

* Analysis of Finished on an Exterior Door at Spadina House Museum, October 31, 2016
CCI Report No. CSD 5376, CCI 129442

Appendix C:

Arborist Report, dated Aug. 1, 2023. Prepared by Amy Choi Consulting.
Tree Protection Plan, dated Aug. 1, 2023. Prepared by Amy Choi Consulting.

ARBORIST REPORT AND TREE PROTECTION PLAN

PROJECT:

Spadina Musuem (285 Spadina Road)
Toronto, ON

CLIENT:

City of Toronto
c/o
Steven Burgess Architects Ltd.
120 Carlton St., Suite 204
Toronto, ON
M5K 4K2

13 April 2023, revised 1 August 2023

Amy Choi Consulting
www.achoiconsulting.ca
info@achoiconsulting.ca
647.983.8817

TABLE OF CONTENTS

TABLE OF CONTENTS **2**
INTRODUCTION **3**
Existing Conditions and Proposed Works 3
METHODOLOGY **3**
Tree Inventory 3
RESULTS **4**
Tree Inventory 4
ANALYSIS AND DISCUSSION **4**
Tree Removals 4
Tree Preservation 4
Tree Preservation Recommendations 4
Replacement Tree Planting 5
CONCLUSIONS AND RECOMMENDATIONS **5**
REFERENCES **7**
TABLE 1. DETAILED TREE INVENTORY **8**
APPENDIX A. PHOTOS OF THE TREES **13**

INTRODUCTION

An Arborist Report and Tree Protection Plan was completed for Spadina Museum located at 285 Spadina Road in Toronto, Ontario. The subject property is located on the east side of Spadina Road, north of Davenport Road.

The City of Toronto's Street Tree By-law (Toronto Municipal Code Chapter 813, Article II), Private Tree Protection By-law (Toronto Municipal Code Chapter 813, Article III), and Ravine and Natural Feature Protection By-law (Chapter 658) are applicable to the subject property.

Trees protected under the aforementioned by-law are divided into the following categories as stated in *Guidelines for Completion of An Arborist Report* (City of Toronto, 2011):

1. Trees with diameters of 30cm or more, situated on private property on the subject site.
2. Trees with diameters of 30cm or more, situated on private property, within 6m of the subject site.
3. Trees of all diameters situated on City owned parkland within 6m of the subject site.
4. Trees of all diameters situated within lands designated under City of Toronto Municipal Code, Chapter 658, Ravine and Natural Feature Protection
5. Trees of all diameters situated within the City road allowance adjacent to the subject site.

Trees which fall into these categories are protected by by-laws and must be protected from injury and/or will require a permit prior to their injury or removal.

Existing Conditions and Proposed Works

The subject area is currently occupied by Spadina Museum, a greenhouse, existing storage buildings, gravel pathways and driveways, and associated landscaping/gardens. The proposed works include a new 2-storey addition to the existing museum garage, accessibility pathways and parking, and soft landscaping. Refer to the Tree Protection Plan (Figure 1) for the topographic survey (existing conditions) and the proposed site plan.

METHODOLOGY

Tree Inventory

Field assessments to collect tree inventory data were conducted on 22 March 2023. Trees greater than 10 cm diameter at breast height (DBH) within vicinity of impact (6m) on the subject property or neighbouring property, and trees of all sizes within the City road allowance were inventoried.

Species, diameter at breast height (DBH), health, condition and relevant comments were recorded following recommendations found in *Guidelines for Completion of An Arborist Report* (City of Toronto, 2011). Tree resources were located using topographic survey provided. Assessments were limited to ground survey. Neighbouring trees were assessed to the greatest extent possible from subject property limits. Refer to Table 1 for the detailed tree inventory and the Tree Protection Plan (Figure 1) for the location of the trees.

RESULTS

Tree Inventory

A total of 42 individual trees and two tree polygons within the City road allowance, and within 6m of the proposed works on the subject property and neighbouring property. Trees 1 to 121 are located within the City road allowance. Trees 12, 14, 15, 17, 18, 20, 24, and 34 are greater than 30 cm DBH and located on the subject property. Trees 16 and 19 are greater than 30 cm DBH and located on neighbouring property. All remaining trees are located on the subject property and are less than 30 cm DBH. The Ravine and Natural Feature Protection limit is located greater than 80m away from the proposed works.

Tree species found include: Accolade Elm (*Ulmus* 'Morton'), American Chestnut x Chinese Chestnut (*Castanea dentata* x *mollissima*), Amur Corktree (*Phellodendron amurense*), Apple species (*Malus* spp.), Black Locust (*Robinia pseudoacacia*), Blue Spruce (*Picea pungens*), Cherry species (*Prunus* spp.), Common Lilac (*Syringa vulgaris*), Eastern White Cedar (*Thuja occidentalis*), Horsechestnut (*Aesculus hippocastanum*), Norway Maple (*Acer platanoides*), Ohio Buckeye (*Aesculus glabra*), Pear species (*Pyrus* sp.), Plum species (*Prunus* sp.), Serviceberry (*Amelanchier* sp.), Siberian Elm (*Ulmus pumila*), Sour Cherry (*Prunus cerasus*), Swamp White Oak (*Quercus bicolor*), White Elm (*Ulmus americana*), White Mulberry (*Morus alba*). Refer to the Tree Protection Plan (Figure 1) for the locations of the trees, Table 1 for the detailed tree inventory, and Appendix A for photos of the trees.

ANALYSIS AND DISCUSSION

Tree Removals

The removal of one (1) trees, Tree 12, will be required to accommodate the proposed pathway. The removal of this tree will require a permit.

Tree Preservation

The preservation of all remaining trees will be possible with the use of appropriate tree preservation measures, as described below. Minimum Tree Protection Distances (mTPDs) based on the City's Tree Protection Policy and Specifications for Construction near Trees document (2016) were used for preservation planning. Refer to Table 1 for the mTPD distances.

Tree Preservation Recommendations

Trees 1, 2, 4, 5, and 15 to 19 are located away from the proposed works and/or protected by existing fencing. Tree protection barriers have not been prescribed for these trees; these trees should not be impacted by the proposed works.

Trees 3, 6, 8 to 11, 13, 14, 25 to 43, and tree polygon P44 will be protected by tree protection barriers consisting of a wood frame made of 2" x 4"s and orange snow fence, is to be installed in accordance with the Tree Protection Plan (Figure 1).

Trees 20 to 22, 24, and tree polygon P23 will be protected by tree protection barriers should consisting of a wood frame made of 2" x 4"s and plywood hoarding, to be installed in accordance with the Tree Protection Plan (Figure 1).

Minor encroachment into the mTPZs of Trees 10 and 11 will be required to accommodate the proposed pedestrian entrance and/or soft landscaping. Any existing gravel base should be re-utilized, where possible. Any soft landscaping should be completed towards the end of construction, following the installation of the pedestrian entrance. Any work within the mTPZs of trees shall be completed using hand-tools only and supervised by a Certified Arborist. A permit will be required for the injury of these trees.

Minor to moderate encroachment into the mTPZs of Trees 14, 20, tree polygon P23 and Tree 24 will be required to accommodate the proposed addition footing, curbs, pathway, grading/fill, shed re-location, and/or soft landscaping. Any work within the mTPZs of trees shall be completed using hand-tools only and supervised by a Certified Arborist. Tree 24 should be monitored annually for changes in health, condition, and structural stability for a minimum period of two years following construction. A permit will be required for the injury of Trees 14, 20, and 24.

The tree protection barriers should be installed prior to construction and remain in place throughout the construction process, as specified in the Tree Protection Plan (Figure 1). No grade changes, storage of materials or equipment is permitted within the tree protection zones (TPZ), unless specified otherwise in this report. Minimum tree protection zones (mTPZs), tree protection barriers and tree protection notes, as outlined in *Tree Protection Policy and Specifications for Construction near Trees* (City of Toronto, 2016), are shown on the Tree Protection Plan (Figure 1). Minimum tree protection distances (mTPDs) are shown in Table 1.

Replacement Tree Planting

To compensate for the removal of Tree 12, a total of three (3) trees will need to be planted, as a ratio of 3:1 trees planted to trees removed. Replacement trees should be 50mm caliper deciduous trees and located a minimum of 2m from property lines and hard surfaces, 3m from existing/proposed structures, and 6m from existing mature trees.

CONCLUSIONS AND RECOMMENDATIONS

A total of 42 individual trees and two tree polygons within the City road allowance, and within 6m of the proposed works on the subject property and neighbouring property. The removal of one (1) tree, and the injury of five (5) trees will be required to accommodate the proposed works and will require a permit. The majority of the trees will be preserved, assuming the tree protection measures noted in this report are implemented.

Tree protection measures should be installed prior to any construction work, as discussed in this report. Tree protection barriers should be implemented at distances noted in Table 1 and shown in the Tree Protection Plan (Figure 1) and maintained throughout the demolition and construction process. Refer to Detail TP-1, tree protection notes, and signage on the Tree Protection Plan (Figure 1) for further information regarding tree protection as outlined by the City of Toronto.

Respectfully Submitted,

Amy Choi, B.Sc.(Env.), M.Sc.F.
Principal, Consulting Arborist and Forest Ecologist
ISA Certified Arborist #ON-1609A
ISA Tree Risk Assessment Qualified
Certified Butternut Assessor #024

Amy Choi Consulting
www.achoiconsulting.ca
info@achoiconsulting.ca
647.983.8817

REFERENCES

City of Toronto: Parks, Forestry & Recreation, Urban Forestry. 2011. Guidelines for the Completion of An Arborist Report.
http://www.toronto.ca/trees/pdfs/arboristreportguidelines.pdf

City of Toronto: Parks, Forestry & Recreation, Urban Forestry. 2016. Tree Protection Policy and Specifications for Construction near Trees.
https://www1.toronto.ca/city_of_toronto/parks_forestry__recreation/urban_forestry/files/pdf/TreeProtSpecs.pdf

Toronto Municipal Code. 2013. Chapter 658: Ravine and Natural Feature Protection.
https://www.toronto.ca/legdocs/municode/1184_658.pdf

Toronto Municipal Code. 2013. Chapter 813, Article II: Trees on City Streets
http://www.toronto.ca/legdocs/municode/1184_813.pdf

Toronto Municipal Code. 2013. Chapter 813, Article III: Private Tree Protection
http://www.toronto.ca/legdocs/municode/1184_813.pdf

TABLE 1. DETAILED TREE INVENTORY

Location: Spadina Museum, Toronto Date: 22 March 2023 Surveyors: AC

Tree #	Common Name	*Scientific Name*	Diameter at Breast Height (DBH)	Trunk Integrity	Crown Structure	Crown Vigour	Crown Dieback	Dripline (radius)	Category	minimum Tree Protection Zone (mTPZ) (radius)[1]	Comments	Proposed Action	Ownership
			(cm)	*Good (G), Fair (F), Poor (P)*			*%*	*(m)*	*(1-5)*	*(m)*			
1	White Mulberry	*Morus alba*	29,45 [54]	F	F	F		6.5	5	3.6	Moderate pruning wounds, utility pole and lines through crown, union at base with significant included bark and decay, minor lean towards the road	Preserve	City (ROW)
2	Amur Corktree	*Phellodendron amurense*	7	G	G	G		1	5	1.2		Preserve	City (ROW)
3	Swamp White Oak	*Quercus bicolor*	5	G	G	G		0.5	5	1.2		Preserve	City (ROW)
4	Ohio Buckeye	*Aesculus glabra*	7	FG	G	G		1	5	1.2	Minor stem wound at base with decay, minor asymmetrical crown	Preserve	City (ROW)
5	Accolade Elm	*Ulmus* 'Morton'	14	G	G	FG		3	5	1.8	Minor epicormic branches	Preserve	City (ROW)
6	Cherry species	*Prunus sp.*	12	F	F	F		1	5	1.8	Significant seam/stem wound with decay, minor pruning wounds, multiple branch attachments, minor epicormic branches	Preserve	City (ROW)
7	Cherry species	*Prunus sp.*	10	FP	F	FP		1	5	1.8	Significant open seam/stem wound with decay, minor epicormic branches	Preserve	City (ROW)
8	Horsechestnut	*Aesculus hippocastanum*	80	F	F	F		5	5	4.8	Moderate deadwood with decay, crooks in branches, moderate previous broken branches, stem wound at root flare with decay	Preserve	City (ROW)
9	Ohio Buckeye	*Aesculus glabra*	6	G	G	G		1.5	5	1.2		Preserve	City (ROW)
10	Siberian Elm	*Ulmus pumila*	71	F	F	F		9	5	4.8	Minor lean towards the road, Moderate pruning wounds with decay, moderate epicormic branches	Preserve - injure	City (ROW)

Tree #	Common Name	*Scientific Name*	Diameter at Breast Height (DBH)	Trunk Integrity	Crown Structure	Crown Vigour	Crown Dieback	Dripline (radius)	Category	minimum Tree Protection Zone (mTPZ) (radius)[1]	Comments	Proposed Action	Ownership
			(cm)	*Good (G), Fair (F), Poor (P)*			*%*	*(m)*	*(1-5)*	*(m)*			
11	White Elm	*Ulmus americana*	79	FP	F	FP		7	5	4.8	Moderate epicormic branches, seams from ribbing, decay, minor lean to the southeast, moderate pruning wounds with decay	Preserve - injure	City (ROW)
12	Blue Spruce	*Picea pungens*	48	FG	FG	F		4	1	3.0	Minor stem wounds due to raised crown, minor crook, minor deadwood, minor chlorosis	Remove	City (private)
13	Serviceberry	*Amelanchier sp.*	6,10 [12]	FG	F	F		2		1.8	Moderate epicormic branches, union at base, moderate lean to the east, one stem removed	Preserve	City (private)
14	Norway Maple	*Acer platanoides*	81	F	FG	FG		11	1	5.4	Moderate pruning wounds with decay, minor epicormic branches, hanger, minor deadwood, minor lean to the northeast	Preserve - injure	City (private)
15	White Mulberry	*Morus alba*	48	F	F	F		7	1	3.0	Wetwood, moderate bow to the south, moderate epicormic branches, small root flare	Preserve	City (private)
16	Norway Maple	*Acer platanoides*	~45	FG	F	F		6	2	3.0	Narrow branch unions	Preserve	Neighbouring (private)
17	White Mulberry	*Morus alba*	54	FP	F	FP		8	1	3.6	Small root flare, minor lean to the southeast, moderate epicormic branches, shear crack, wetwood, narrow branch unions	Preserve	City (private)
18	Norway Maple	*Acer platanoides*	53	FG	FG	F		6	1	3.6	Minor pruning wounds, minor deadwood with decay, minor epicormic branches	Preserve	Neighbouring (private)
19	Norway Maple	*Acer platanoides*	~50	FP	F	F		6	2	3.0	Moderate lean to the northwest, moderate stem wound with decay	Preserve	City (private)
20	White Elm	*Ulmus americana*	71	F	F	F		8	1	4.8	Minor lean to the northwest, moderate epicormic branches, moderate pruning wounds with decay	Preserve - injure	City (private)

Tree #	Common Name	*Scientific Name*	Diameter at Breast Height (DBH)	Trunk Integrity	Crown Structure	Crown Vigour	Crown Dieback	Dripline (radius)	Category	minimum Tree Protection Zone (mTPZ) (radius)[1]	Comments	Proposed Action	Ownership
			(cm)	*Good (G), Fair (F), Poor (P)*			*%*	*(m)*	*(1-5)*	*(m)*			
21	Eastern White Cedar	*Thuja occidentalis*	5	G	G	G		1.5		1.2		Preserve	City (private)
22	American Chestnut x Chinese Chestnut	*Castanea dentata x mollissima*	29	G	FG	G		4		1.8	Missing leader	Preserve	City (private)
P23	Common Lilac	*Syringa vulgaris*	2-17	FG	FG	FG		3		1.8	2 trees, multi-stemmed at base	Preserve - injure	City (private)
24	Black Locust	*Robinia pseudoacacia*	106	F	F	F		10	1	6.4	Co-dominant at 4m with moderate included bark, cross-branch, moderate epicormic branches, cabled	Preserve - injure	City (private)
25	Sour Cherry	*Prunus cerasus*	14,17 [22]	F	FG	F		3		1.8	Small root flare, minor pruning wounds, union at 1m with moderate included bark, moderate epicormic branches, black knot	Preserve	City (private)
26	Apple species	*Malus sp.*	9,13 [16]	FG	FG	FG		2		1.8	Minor pruning wounds, minor epicormic branches, small root flare	Preserve	City (private)
27	Apple species	*Malus sp.*	17,15,14 [27]	F	F	F		2		1.8	Minor pruning wounds with decay, minor epicormic branches, small root flare, union at 1.2m	Preserve	City (private)
28	Apple species	*Malus sp.*	18	FP	F	F		2		1.8	Main stem missing, moderate stem wounds on stem and base with decay, supported overextended branch	Preserve	City (private)
29	Apple species	*Malus sp.*	13,8,13,24 [31]	FG	FG	FG		2		2.4	Minor epicormic branches, minor pruning wounds, small root flare	Preserve	City (private)
30	Apple species	*Malus sp.*	13	FG	FG	FG		2		1.8	Minor lean, minor seam, minor pruning wounds, minor epicormic branches, small root flare	Preserve	City (private)
31	Apple species	*Malus sp.*	12,15 [19]	FG	FG	FG		3		1.8	Multiple branch attachments at 1m, minor epicormic branches, minor pruning wounds, small root flare	Preserve	City (private)

Tree #	Common Name	*Scientific Name*	Diameter at Breast Height (DBH)	Trunk Integrity	Crown Structure	Crown Vigour	Crown Dieback	Dripline (radius)	Category	minimum Tree Protection Zone (mTPZ) (radius)[1]	Comments	Proposed Action	Ownership
			(cm)	*Good (G), Fair (F), Poor (P)*			*%*	*(m)*	*(1-5)*	*(m)*			
32	Apple species	*Malus sp.*	26,16 [31]	FG	FG	FG		3		2.4	Minor epicormic branches, minor pruning wounds, small root flare, multiple branch attachments	Preserve	City (private)
33	Apple species	*Malus sp.*	26	FG	FG	F		3		1.8	Minor epicormic branches, minor pruning wounds, small root flare, wetwood	Preserve	City (private)
34	Apple species	*Malus sp.*	35	FP	FP	FP		2	1	2.4	Burls at base, cavity at base, Significant pruning wounds with decay, sloughing bark, moderate epicormic branches, hollow/crack	Preserve	City (private)
35	Pear species	*Pyrus sp.*	<2	FG	FG	FG		0.5		1.2	Minor lean, minor pruning wounds	Preserve	City (private)
36	Plum species	*Prunus sp.*	11,11,17 [23]	FG	FG	FG		2		1.8	Moderate pruning wounds, moderate epicormic branches, union at 1m, small root flare	Preserve	City (private)
37	Apple species	*Malus sp.*	19	FG	FG	FG		3		1.8	Moderate epicormic branches, small root flare, minor pruning wounds	Preserve	City (private)
38	Apple species	*Malus sp.*	14,25 [29]	F	F	FG		3		1.8	Crooks, minor epicormic branches, minor pruning wounds	Preserve	City (private)
39	Apple species	*Malus sp.*	17	FG	FG	FG		3		1.8	Minor epicormic branches, minor pruning wounds	Preserve	City (private)
40	Apple species	*Malus sp.*	21	FG	FG	FG		3		1.8	Small root flare, minor epicormic branches, minor pruning wounds	Preserve	City (private)
41	Apple species	*Malus sp.*	25,16 [30]	FG	FG	FG		3		2.4	Small root flare, minor epicormic branches, moderate pruning wounds with decay	Preserve	City (private)
42	Apple species	*Malus sp.*	22,15,23 [35]	FG	FG	FG		4		2.4	Small root flare, minor epicormic branches, moderate pruning wounds with decay, seams, minor stem wound at base	Preserve	City (private)

Tree #	Common Name	*Scientific Name*	Diameter at Breast Height (DBH)	Trunk Integrity	Crown Structure	Crown Vigour	Crown Dieback	Dripline (radius)	Category	minimum Tree Protection Zone (mTPZ) (radius)[1]	Comments	Proposed Action	Ownership
			(cm)	*Good (G), Fair (F), Poor (P)*			*%*	*(m)*	*(1-5)*	*(m)*			
43	Apple species	*Malus sp.*	23	FG	FG	FG		3		1.8	Small root flare, minor epicormic branches, moderate pruning wounds with decay, multiple branch attachments at 1m, shear crack	Preserve	City (private)
P44	Common Lilac	*Syringa vulgaris*	2-15	FG	FG	FG		varies		1.8	Cluster of trees	Preserve	City (private)
END													

[1] MTPZdistances are to be measured from the outside edge of the tree base towards the dripline and may be limited by an existing paved surface, provided the existing paved surface remains intact throughout the construction work.

APPENDIX A. PHOTOS OF THE TREES

Photo 1. Tree 1 (left), view looking north

Photo 2. Tree 2, view looking east

Photo 3. Tree 3, view looking east

Photo 4. Tree 4, view looking east

Photo 5. Tree 5, view looking southeast

Photo 6. Tree 6, view looking southeast

Photo 7. Tree 7, view looking southeast

Photo 8. Tree 8, view looking southeast

Photo 9. Tree 9, view looking southeast

Photo 10. Trees 10 and 11 (right and left), view looking southeast

Photo 11. Tree 12, view looking north

Photo 12. Tree 13, view looking southwest

Photo 13. Tree 14, view looking southwest

Photo 14. Trees 15 and 16 (centre and right), view looking northwest

Photo 15. Trees 18 and 19 (right and left), view looking northeast

Photo 16. Tree 20, view looking southwest

Photo 17. Tree 21, view looking southwest

Photo 18. Tree 22, view looking east

Photo 19. Tree polygon P23, view looking northwest

Photo 20. Tree 24, view looking northwest

Photo 21. Trees, 25 to 27 (centre, left, right), view looking northeast

Photo 22. Tree 28, view looking southwest

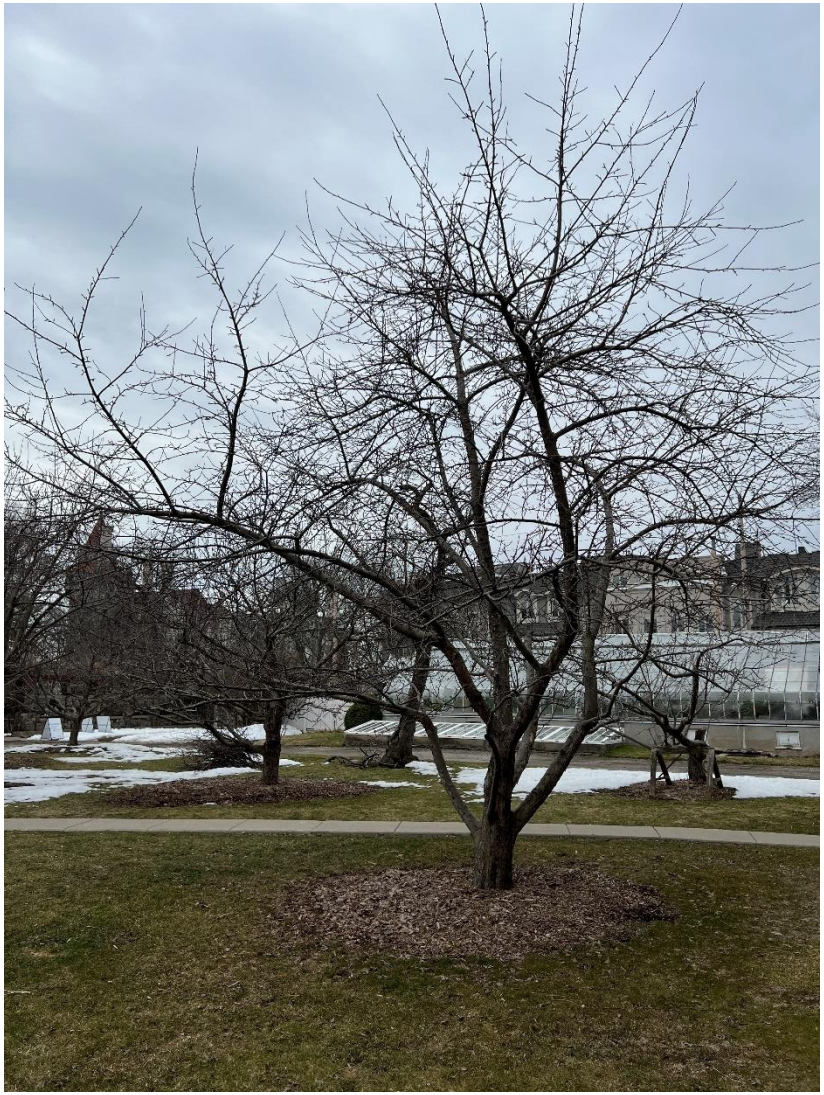


Photo 23. Tree 29, view looking southwest

Photo 24. Tree 30, view looking southwest

Photo 25. Tree 31, view looking southeast

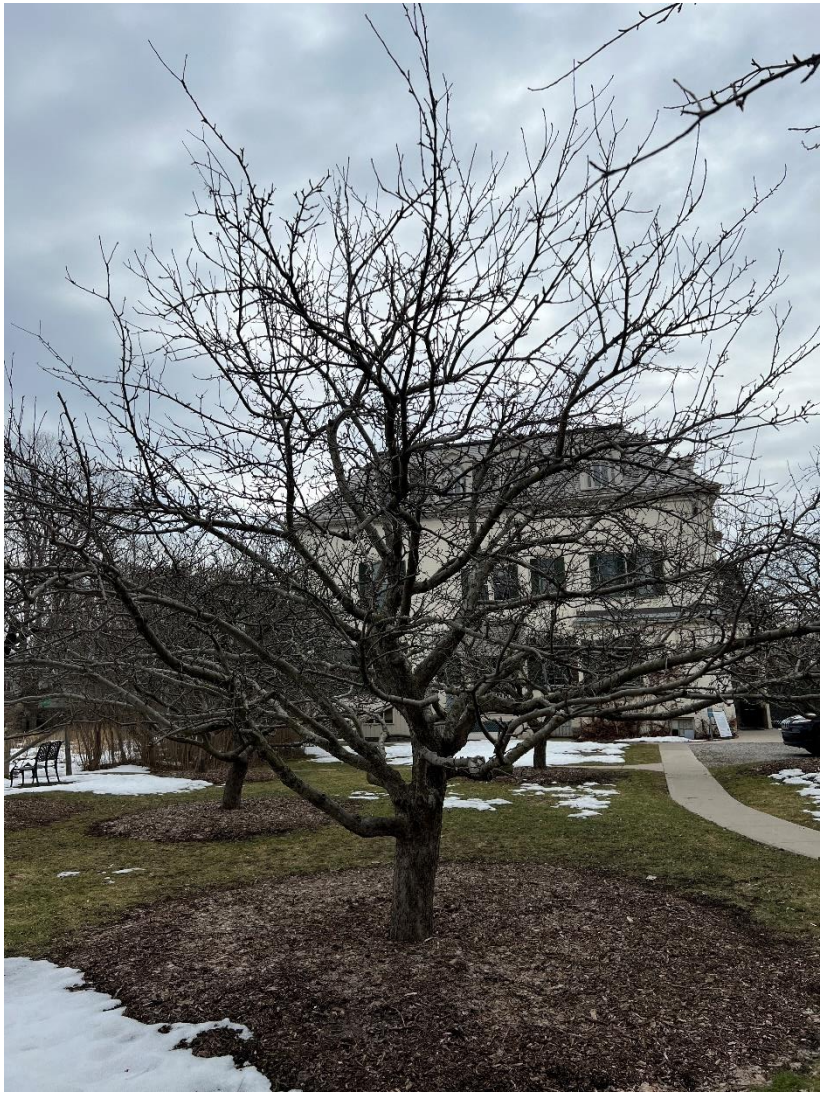


Photo 26. Tree 32, view looking south

Photo 27. Trees 33 and 34, view looking south

Photo 28. Tree 35, view looking east

Photo 29. Tree 36, view looking east

Photo 30. Tree 37, view looking east

Photo 31. Tree 38, view looking southeast

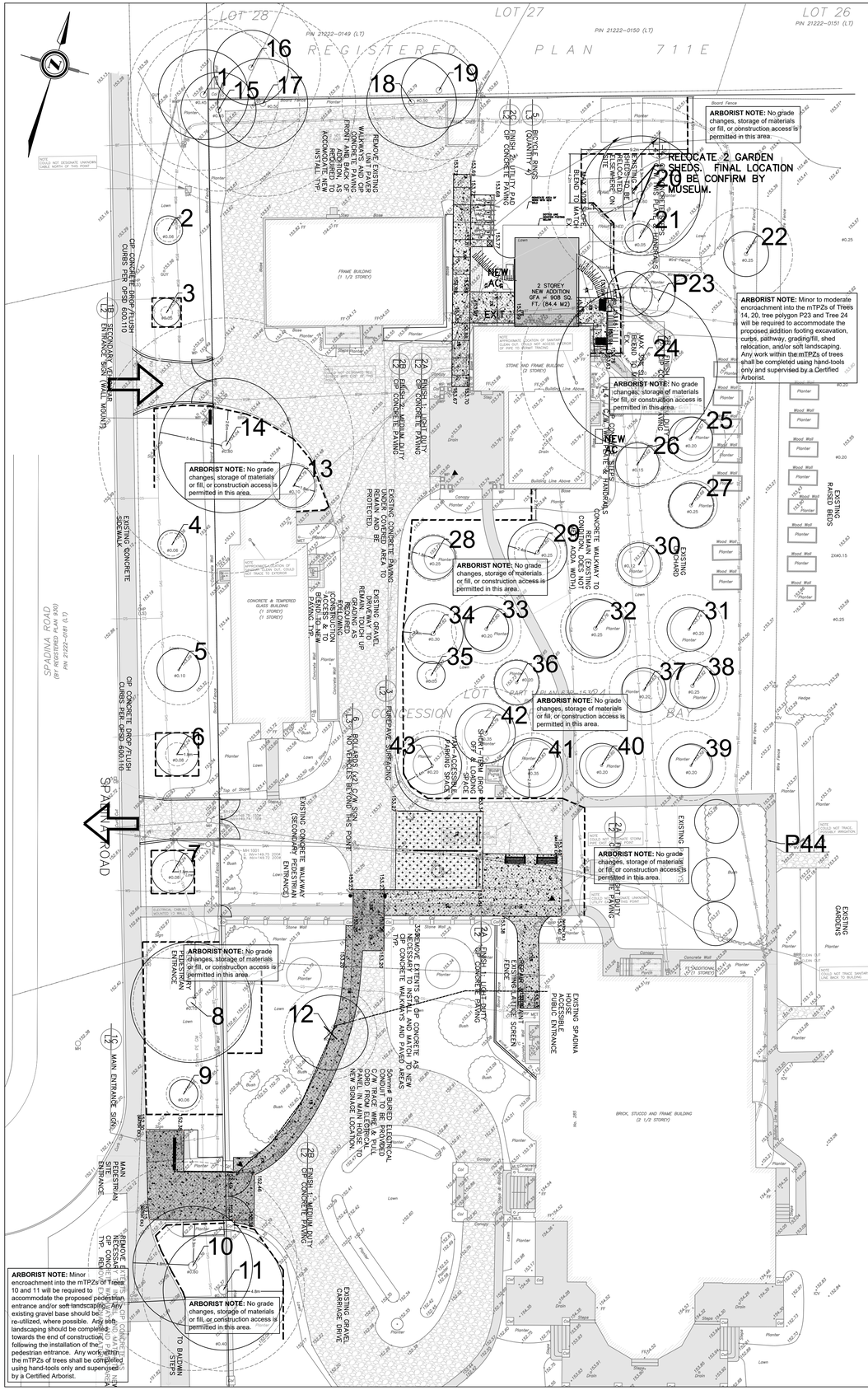
Photo 32. Tree 39, view looking southeast

Photo 33. Trees 40 and 41 (left and right), view looking southeast

Photo 34. Tree 42, view looking southeast

Photo 35. Tree 43, view looking southeast

Photo 36. Tree polygon P44, view looking east


LOT 28
LOT 27
LOT 26
PIN 21222-0149 (LT)
PIN 21222-0150 (LT)
PIN 21222-0151 (LT)
REGISTERED PLAN 711E
SPADINA ROAD
(BY REGISTERED PLAN 930)
PIN 21222-0181 (LT)
CONCESSION 2 FROM THE BAY
LOT PART PLAN 930 153A
ARBORIST NOTE: No grade changes, storage of materials or fill, or construction access is permitted in this area.
ARBORIST NOTE: Minor encroachment into the mTPZs of Trees 10 and 11 will be required to accommodate the proposed pedestrian entrance and/or soft landscaping. Any existing gravel base should be re-utilized, where possible. Any soft landscaping should be completed towards the end of construction, following the installation of the pedestrian entrance. Any work within the mTPZs of trees shall be completed using hand-tools only and supervised by a Certified Arborist.
ARBORIST NOTE: Minor to moderate encroachment into the mTPZs of Trees 14, 20, tree polygon P23 and Tree 24 will be required to accommodate the proposed addition footing excavation, curbs, pathway, grading/fill, shed relocation, and/or soft landscaping. Any work within the mTPZs of trees shall be completed using hand-tools only and supervised by a Certified Arborist.
1. RELOCATE 2 GARDEN SHEDS. FINAL LOCATION TO BE CONFIRM BY MUSEUM.
NEW ACCESSIBLE PUBLIC ENTRANCE
2 STOREY NEW ADDITION GFA = 908 SQ FT. (84.4 M2)
EXISTING SPADINA HOUSE ACCESSIBLE PUBLIC ENTRANCE
EXISTING GARDENS
EXISTING RESIDENTIAL
EXISTING CARRIAGE DRIVE
EXISTING GRAVEL DRIVEWAY TO REMAIN AND BE PROTECTED
EXISTING RAISED BEDS
EXISTING FLAGPOLE
EXISTING CONCRETE WALKWAY TO REMAIN AND BE PROTECTED
EXISTING CONCRETE PAVING TO REMAIN AND BE PROTECTED
EXISTING CONCRETE WALKWAY