HWDSB

P02081 Holbrook Elementary School Gym Renovation and Air Handling Unit Replacement

450 Sanatorium Road, Hamilton, ON

AMRA J
ARCHITECTS INC.

Pages

INTRODUCTORY INFORMATION

Hamilton Wentworth District School Board – Front End Documents

Division 01 – General Requirements

.

Division 02 – Existing Conditions

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Division 04 – Masonry (refer to drawings)

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STRUCTURAL DRAWINGS

END OF THIS SECTION

1. Designated Substance Audit Report

1. A copy of the following report with respect to the identified portion of the Work is being made available as part of the Bid Documents; files titled as follows:

.1 Titled: Holbrook Elementary School

Gym Renovations and AHU Replacement

Prepared by: MTE Consultants Inc.

File No.: 60595_001

Dated: January 30, 2025

No. of Pages: 46

.2 Abatement Specifications (#pages 15)

3. These reports provide detailed descriptions of the assessment criteria, findings, recommendations and limitations with respect to toxic or hazardous materials present at the identified property.

4. The reports, by their nature, cannot reveal all conditions that exist or can occur. Should conditions, in the opinion of the Consultant, be found to vary substantially from the report, changes in the scope of Work will be made, with resulting credits or expenditures to the Contract Price accruing to the Owner.

5. *HWDSB Construction School Specific Information Sheet*

1. Refer to attached HWDSB Appendix A instructions and information sample sheet, of construction site specific protocols the contractor will be required to follow. (6 pages)

End of Section

Holbrook Elementary School

Gym Renovations & AHU Replacement

Designated Substance Audit Report

Project Location:
450 Sanatorium Road, Hamilton, ON

Prepared for:
Hamilton-Wentworth District School Board
20 Education Court, Hamilton, ON

Prepared by:

MTE Consultants Inc.
1016 Sutton Drive, Unit A
Burlington, ON L7L 6B8

January 29, 2025
Revised: January 30, 2025

MTE File No.: 60595_001

Engineers, Scientists, Surveyors.

Contents

Appendices

1.0 INTRODUCTION

1.1 Authorization

MTE Consultants Inc. (MTE) was retained by Hamilton-Wentworth District School Board (the Client) to conduct a Designated Substance Audit for Holbrook Elementary School located at 450 Sanatorium Road in Hamilton, Ontario.

The purpose of the audit was to identify the presence of Designated Substances within the building in accordance with Section 30 of the Occupational Health & Safety Act (OHSA), in advance of gymnasium renovations and Air Handling Unit (AHU) replacement. This report meets the requirements of Section 30 of the OHSA and the requirements of Ontario Regulation (O. Reg.) 278/05.

2.0 SCOPE OF WORK

As requested by the Client, this assessment was limited to the following areas and materials:

- Existing Gymnasium (143) – Floors, Walls and Ceilings;
- Existing Gymnasium Storage (143C) – Floors, Walls and Ceilings;
- Existing Corridors (119, 125, 134) – Walls and Ceilings;
- Existing Kindergarten (126, 126A 126B, 126C) – Walls and Ceilings;
- Existing Kindergarten (127, 127A 127B, 127C, 127D) – Walls and Ceilings;
- Existing Staff Room (128) – Walls and Ceilings;
- Existing Kitchen (130) – Walls and Ceilings;
- Existing Classroom (131) – Floors, Walls and Ceilings,
- Existing Mechanical Room (206A) – Walls and Ceilings; and,
- Exterior roof.

These areas are depicted on the Figures provided as Appendix C and are hereafter referred to in the following sections as the “Subject Areas”.

Unless otherwise noted above, floor finishes will not be impacted by the proposed work and were excluded from the scope of this assessment. It is possible that asbestos-containing floor tiles and mastic are present within various classrooms, staff rooms and kitchen; therefore if the scope of renovations expands to impact these materials, additional investigation and testing of these materials should be performed.

The Scope of Work for this assessment was completed by MTE and included the following activities:

- Review of existing or historical reports and documentation pertaining to Designated Substances within the building;
- Visual inspection of accessible locations within the Subject Area to identify the following suspect Designated Substances and Hazardous Building Materials:
  - Asbestos;
  - Lead;
  - Mercury;

    - Silica;
    - Mould growth;
    - Ozone Depleting Substances;
    - Polychlorinated Biphenyls limited to fluorescent light ballasts;
- The following Designated Substances are not expected to be present due to the building use or in a form that is hazardous: Acrylonitrile, Arsenic, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, and Vinyl Chloride;
- Collection of bulk building material samples suspected to contain asbestos;
- Collection of paint scrape samples suspected to contain lead;
- Submission of samples to an accredited and/or qualified laboratory;
- Interpretation of laboratory results; and,
- Preparation of this report of findings and recommendations.

3.0 METHODOLOGY AND ASSESSMENT CRITERIA

This audit was conducted using visual and laboratory identification methods for the assessment of materials outlined in Section 2.0 and their corresponding location and use. Materials that are determined to be asbestos-containing materials (ACM) are further classified by their friability and condition. The areas outlined in Section 2.0 were inspected and limited to building components, materials and service connections. Notwithstanding that reasonable attempts were made to identify all Designated Substances, the possibility of concealed substances and material exists and may not become visible until substantial demolition has occurred and therefore are currently undocumented. All work was conducted in accordance with industry accepted methods and MTE Standard Operating Procedures and did not include the following:

- Materials indicated in this report as “Potentially Concealed”;
- Locations that may be hazardous to the surveyor (located at heights, electrical equipment, confined spaces);
- Where invasive inspection could cause consequential damage to the property or impair the integrity of the equipment, such as roof system, sealants, exterior finishes, underground services or components of mechanical equipment;
- Locations concealed by building finishes that require substantial demolition or removal for access or determination of quantities (plumbing or electrical lines);
- Non-permanent items or personal contents, furnishings; and,
- Settled dust or airborne agents unless otherwise stated.

4.0 ASSESSMENT AND RESULTS

An inspection of the building was conducted by MTE on December 17 and 18, 2024.

A description of the building and assessed finishes is provided below. Refer to Section 4.1 for a summary of findings.

Building Element	Description
Exterior Finishes	Concrete Brick veneer and mortar Sealants Flat roof system Sloped roof system
Mechanical Systems/Insulations	Boiler heating Roof mounted central air conditioning
	Parging on pipe fittings Fibreglass insulation on pipe straights Fibreglass duct insulation
Electrical/Plumbing Systems	Fluorescent Light tubes Copper piping with solder
Floor Finishes	Vinyl floor tiles Carpet Concrete Terrazzo
Wall Finishes	Concrete
Ceiling Finishes	Drywall 2’ x 4” Small Fissure Random Pinhole ceiling tiles 2’ x 2’ Random Fissure Pattern ceiling tiles

4.1 Findings and Analytical Results

A summary of sampling locations and analytical results are included in **Appendix A**.

Laboratory certificates of analysis are included in **Appendix B**.

Figures of inspected areas are included in **Appendix C**.

A photographic log was included in **Appendix D.**

A detailed summary of findings and recommended actions is provided in **Table 4.3 of Appendix A.**

4.1.1 Asbestos

Asbestos was used in building materials throughout the years with a peak usage in the 1950s and 1960s. While the manufacture of most ACM was banned in the 1970s, buildings constructed in the 1980s have the potential for ACM as well. In 1986, legislation limiting the use of asbestos in consumer products was introduced.

As part of this inspection, a total of 61 bulk samples of suspect ACM were submitted for asbestos analysis with a total of 66 analyses being performed. The difference between the number of samples submitted and the number of samples analysed can be a function of either the stop-positive method or the requirement of analyzing multiple layers, performed by the laboratory, from a single sample reported as additional samples or subsets of a sample.

Bulk samples were submitted for asbestos analysis to Paracel Laboratories Ltd. (Paracel), in Mississauga, Ontario. Paracel is certified under the Canadian Association of Laboratory Accreditation to perform asbestos analysis of bulk samples (accreditation number A3762). Laboratory analysis was conducted in accordance with the United States Environmental Protection Agency (USEPA), Test Method EPA/600-R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, June, 1993 by Polarized Light Microscopy (PLM) as prescribed by O. Reg. 278/05.

As reported by the Client, vinyl floor tiles and associated mastic within the existing Gymnasium Storage Room (143C) were previously identified as asbestos-containing. These materials are assumed to contain asbestos and were not resampled as part of this assignment.

As further reported by the Client, a member of their maintenance staff performed an intrusive inspection of block wall cavities at the Site and confirmed that no vermiculite was present.

Based on the laboratory results and visual identification, ACM was confirmed present at the time of the inspection. In addition, suspect ACM was either observed or may potentially be concealed by building finishes.

4.1.2 Lead

Lead was historically used in mortar pigments, ceramic glazing; plumbing solder, electrical equipment and electronics solder, in pipe gaskets as packing in cast iron bell and spigot joints of sanitary drains, flexible plumbing connections, flashing panels, acoustical dampeners, phone cable casing and some architectural applications. In buildings constructed after 1990, these applications are no longer applicable outside of specialized uses (shielding for medical imaging etc.).

As part of this inspection, a total of 7 paint scrape samples were collected from surfaces and represent the paint colours observed throughout the Subject Areas.

Samples were submitted for laboratory analysis by ASTM D3335-85A “Standard Method to Test for Low Concentrations of Lead in Paint by Atomic Absorption Spectrophotometry” following MOE Method E3470 Inductively Coupled Plasma Optical Emission Spectrometry to Paracel Laboratories Ltd., in Ottawa, Ontario. Paracel is accredited by the Canadian Association of Laboratory Accreditation to perform bulk lead analysis of paint.

Based on the laboratory results and visual identification, no lead-containing materials were confirmed present at the time of the inspection; however, lead-containing solder on copper pipe connections or lead pipe gaskets may potentially be concealed in buried lines or wall cavities.

4.1.3 Mercury

Mercury is typically used in building service applications such as fluorescent light tubes, compact fluorescent bulbs, metal halide (sodium halide) lamp bulbs, and neon lights as a vapour. Mercury may exist in thermostats and pipe or mechanical equipment thermometers as a liquid. Mercury is presumed to be present in the above materials.

Mercury-containing materials were visually identified at the time of the inspection.

4.1.4 Silica

Silica is present in rock, stone, soil, and sand. Masonry products such as concrete block, brick, and mortar, as well as concrete and associated products contain silica. Due to its ubiquitous nature, silica was historically used in a wide variety of building materials and is still used today in new construction.

Building materials that are presumed to contain silica were visually identified at the time of the inspection.

4.1.5 Mould

No water damaged or mould growth impacted building materials were observed during the inspection.

4.1.6 Polychlorinated Biphenyls (PCB)

Suspect PCB-containing light ballasts were visually identified during the inspection. All live electrical equipment that could not be properly and safely de-energized was not assessed, therefore light ballasts were not inspected. Light ballasts which were not accessed, will require additional investigation to determine their PCB content when removed from service.

4.1.7 Ozone-Depleting Substances (ODS)

ODS are chemical compounds that include chlorofluorocarbons (cfcs), hydrochlorofluorocarbons (hcfcs), halons, methyl bromide, carbon tetrachloride, hydrobromofluorocarbons, chlorobromomethane, and methyl chloroform which are widely used in cooling and refrigeration. The use of ODS is regulated under Ontario Regulation 463/10 *Ozone Depleting Substances and Other Halocarbons* Made under the Environmental Protection Act.

Building components presumed to contain ODS were identified at the time of the inspection.

4.2 Conclusions and Recommendations

A detailed summary of recommended actions is provided in **Table 4.3 of Appendix A**.

In accordance with Section 30 of OHSA and Section 8 of O. Reg. 278/05, the Owner must provide a copy of this report to all contractors doing work at the building. The Owner must also provide a copy of this report to all prospective contractors.

Should any additional suspect Designated Substances be discovered during building renovation demolition, work in the vicinity should cease and the materials should not be disturbed until proper notification, testing and abatement instructions are provided. All waste generated as a result of any and all work at the Site must be handled, transported and disposed of in accordance with Ontario Regulation 347 made under the Environmental Protection Act and local by-laws. Based on the assessment findings and analytical results, the following abatement measures are presented. It should be noted that the recommended actions are the minimum required actions, as prescribed by the appropriate Acts, regulations, guidelines, standards, codes and general best practice measures.

4.2.1 Asbestos

ACMs were identified during the assessment. If these materials, including those deemed or suspected, will be disturbed, or will likely be disturbed, during building maintenance, renovations, construction, or demolition activities, they must be handled and disposed of in accordance with the procedures prescribed by O. Reg. 278/05.

All asbestos work must be conducted by contractors who are trained in the type of asbestos operations required, and should be overseen by a qualified third party Health, Safety and Environmental professional. In order to conduct Type 3 asbestos operations, contractors must be certified as Asbestos Abatement Workers AAW (Trade code 253W) and Asbestos Abatement Supervisors AAS (Trade code 253S) by The Ministry of Training, Colleges and Universities (Ministry of Advanced Education and Skills Development) as prescribed by Section 20 of O. Reg. 278/05. Suspect or visually confirmed ACM must be deemed to be asbestos-containing and treated as if they contain a type of asbestos other than Chrysotile.

ACM may also be present in concealed locations and if construction, renovation, alteration, or maintenance activities are planned, invasive inspections of concealed locations for potential ACM must be performed prior to such activities.

Should any suspect ACM be discovered during the course of construction, renovation, alteration, or maintenance activities, work which disturbs the material must cease immediately. Suspect ACM must be treated as asbestos-containing or sampled prior to disturbance to assess the presence of asbestos.

4.2.2 Lead

No lead-containing materials were confirmed present during the assessment, however, low level lead-containing paint is present and the following general procedures are recommended as a precautionary measure as per the Environmental Abatement Council of Canada's (EACC) *Lead Guideline for Construction, Renovation, Maintenance or Repair (October 2014)*:

- General dust control;
- The washing of hands and face at on-site facilities;
- No smoking, eating, chewing gum or drinking in the work area; and,
- No removal of painted surfaces by means of abrasive blasting.

4.2.3 Mercury

Mercury-containing materials were identified. All mercury containing materials or sources should be removed, intact, prior to any work which may disturb or damage them and cause worker exposure to mercury liquid and/or vapour.

On-site crushing of mercury-containing materials should not occur. Care should be taken to ensure safe storage of the above until recycling or disposal can be coordinated. Under current legislation, mercury waste requires handling and disposal in accordance with Ontario Regulation 490/09 of the OHSA and Ontario Regulation 347 of the Environmental Protection Act.

4.2.4 Silica

Silica is presumed to be present; therefore, special requirements for management and handing are required. The contractor should also consult MOL Occupational Health and Safety Branch's Guideline: *Silica on Construction Projects* (April 2011) for the procedures and methods required to remove and dispose of silica-containing materials.

4.2.5 Mould

No water damage or suspect mould growth was observed during the assessment therefore no special management and handling requirements are warranted.

4.2.6 Polychlorinated Biphenyls (PCB)

Suspect PCB-containing fluorescent light ballasts were identified but could not be conclusively classified as PCB-containing or non-PCB-containing. These are assumed to contain PCBs and proper removal and disposal shall be performed during removal from service.

Although proper storage and disposal of light ballasts as though they are PCB shall be included in contractor base bids, ballasts can undergo further inspection as they are removed from service to classify as PCB-containing or non-PCB containing. Fixtures will require dismantling to access date stamps (located on the back of the ballast) in order to be correctly classified in accordance with Environment Canada's document "*Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2 (revised), August 1991"*.

Statutory Orders and Regulations (SOR)/2008-273, the *PCB Regulations*, made under the *Canadian Environmental Protection Act,* permits continued use of in-service PCB-containing light ballasts until the end of service life or until December 31, 2025.

4.2.7 Ozone Depleting Substances (ODS)

Building components presumed to contain ODS were identified and special requirements for management, handing and disposal by the owner, constructor, contractor, sub-contractors and workers apply.

Under current legislation, there are no requirements to remove ODSs from service simply because they are present. However, prior to commencing any work where this equipment will be dismantled, destroyed or disposed of, the refrigerant must be drained by a licensed technician and tagged with a notice indicating that the equipment no longer contains refrigerant. The appropriate notices or records shall be maintained in accordance with O. Reg. 463/10 for a minimum of two (2) years and shall include, but not be limited to, service records, transfers/releases of refrigerants, refrigerant types and refrigerant systems.

5.0 LIMITATIONS

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Environmental Engineering & Consulting profession. No other representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of MTE and the Client. It was completed in accordance with the approved Scope of Work referred to in Section 2.0. As such, this report may not deal with all issues potentially applicable to the site and may omit issues that are or may be of interest to the reader. MTE makes no representation that the present report has dealt with all-important environmental features, except as provided in the Scope of Work. All findings and conclusions presented in this report are based on site conditions, as they existed during the time period of the investigation. This report is not intended to be exhaustive in scope or to imply a risk-free facility.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such third parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by any third party as a result of decisions made or actions taken, based upon this report. Others with interest in the site should undertake their own investigations and studies to determine how or if the condition affects them or their plans.

It should be recognized that the passage of time might affect the views, conclusions and recommendations (if any) provided in this report because environmental conditions of a property can change. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may re-assess the contents of this report.

All of which is respectfully submitted,

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Appendix A

Tables

TABLE 4.1: BULK ASBESTOS SAMPLE SUMMARY TABLE				
Sample #	**Location**	**Material Description**	**Asbestos Results (% Type)**	**Is Material ACM**
S01A	GYMNASIUM	12"X12" VINYL FLOOR TILE - BLUE	ND	NO
		MASTIC	ND	NO
S01B	GYMNASIUM	12"X12" VINYL FLOOR TILE - BLUE	ND	NO
		MASTIC	ND	NO
S01C	GYMNASIUM	12"X12" VINYL FLOOR TILE - BLUE	ND	NO
		MASTIC	ND	NO
S02A	GYMNASIUM	PLASTER	ND	NO
S02B	GYMNASIUM	PLASTER	ND	NO
S02C	GYMNASIUM	PLASTER	ND	NO
S03A	SAMPLED IN CORRIDOR BUT OBSERVED THROUGHOUT SUBJECT AREA	CONCRETE BLOCK MORTAR	ND	NO
S03B	SAMPLED IN CORRIDOR BUT OBSERVED THROUGHOUT SUBJECT AREA	CONCRETE BLOCK MORTAR	ND	NO
S03C	SAMPLED IN CORRIDOR BUT OBSERVED THROUGHOUT SUBJECT AREA	CONCRETE BLOCK MORTAR	ND	NO

TABLE 4.1: BULK ASBESTOS SAMPLE SUMMARY TABLE				
Sample #	**Location**	**Material Description**	**Asbestos Results (% Type)**	**Is Material ACM**
S03D	SAMPLED IN 2ND FLOOR MECHANICAL ROOM BUT OBSERVED THROUGHOUT SUBJECT AREA	CONCRETE BLOCK MORTAR	ND	NO
S03E	SAMPLED IN 2ND FLOOR MECHANICAL ROOM BUT OBSERVED THROUGHOUT SUBJECT AREA	CONCRETE BLOCK MORTAR	ND	NO
S04A	SAMPLED IN CORRIDOR BUT OBSERVED IN CLASSROOMS AND STAFF ROOM	2'X2' RANDOM FISSURE CEILING TILE	ND	NO
S04B	SAMPLED IN CORRIDOR BUT OBSERVED IN CLASSROOMS AND STAFF ROOM	2'X2' RANDOM FISSURE CEILING TILE	ND	NO
S04C	SAMPLED IN CORRIDOR BUT OBSERVED IN CLASSROOMS AND STAFF ROOM	2'X2' RANDOM FISSURE CEILING TILE	ND	NO
S05A	**STAFF ROOM KITCHEN**	**DRYWALL JOINT COMPOUND**	**2% CHRYSOTILE**	**YES**
S05B	**STAFF ROOM KITCHEN**	**DRYWALL JOINT COMPOUND**	**NA**	**YES**
S05C	**STAFF ROOM KITCHEN**	**DRYWALL JOINT COMPOUND**	**NA**	**YES**
S06A	CORRIDOR 119	2'X4' SMALL FISSURE RANDOM PINHOLE CEILING TILE	ND	NO
S06B	CORRIDOR 119	2'X4' SMALL FISSURE RANDOM PINHOLE CEILING TILE	ND	NO
S06C	CORRIDOR 119	2'X4' SMALL FISSURE RANDOM PINHOLE CEILING TILE	ND	NO
S07A	**SAMPLED IN THE GYMNASIUM BUT ALSO OBSERVED IN STORAGE ROOM AND MECHANICAL ROOM**	**PIPE ELBOW INSULATION**	**60% CHRYSOTILE**	**YES**

TABLE 4.1: BULK ASBESTOS SAMPLE SUMMARY TABLE				
Sample #	**Location**	**Material Description**	**Asbestos Results (% Type)**	**Is Material ACM**
S07B	**SAMPLED IN THE GYMNASIUM BUT ALSO OBSERVED IN STORAGE ROOM AND MECHANICAL ROOM**	**PIPE ELBOW INSULATION**	**NA**	**YES**
S07C	**SAMPLED IN THE GYMNASIUM BUT ALSO OBSERVED IN STORAGE ROOM AND MECHANICAL ROOM**	**PIPE ELBOW INSULATION**	**NA**	**YES**
S08A	CLASSROOM 131	12"X12" VINYL FLOOR TILE - GREEN	ND	NO
		MASTIC	<MDL	NO
S08B	CLASSROOM 131	12"X12" VINYL FLOOR TILE - GREEN	ND	NO
		MASTIC	<MDL	NO
S08C	CLASSROOM 131	12"X12" VINYL FLOOR TILE - GREEN	ND	NO
		MASTIC	<MDL	NO
S09A	ROOF 2	FLASHING SEALANT	ND	NO
S09B	ROOF 2	FLASHING SEALANT	ND	NO
S09C	ROOF 2	FLASHING SEALANT	ND	NO
S10A	ROOF 2	BROWN MECHANICAL SEALANT	ND	NO

TABLE 4.1: BULK ASBESTOS SAMPLE SUMMARY TABLE				
Sample #	**Location**	**Material Description**	**Asbestos Results (% Type)**	**Is Material ACM**
S10A	ROOF 2	GREY MECHANICAL SEALANT	ND	NO
S10B	ROOF 2	BROWN MECHANICAL SEALANT	ND	NO
		GREY MECHANICAL SEALANT	ND	NO
S10C	ROOF 2	BROWN MECHANICAL SEALANT	ND	NO
		GREY MECHANICAL SEALANT	ND	NO
S11A	EXTERIOR	BRICK MORTAR	ND	NO
S11B	EXTERIOR	BRICK MORTAR	ND	NO
S11C	EXTERIOR	BRICK MORTAR	ND	NO
S11D	EXTERIOR	BRICK MORTAR	ND	NO
S11E	EXTERIOR	BRICK MORTAR	ND	NO
S12A	ROOF 1	MEMBRANE	ND	NO
S12B	ROOF 1	MEMBRANE	ND	NO

TABLE 4.1: BULK ASBESTOS SAMPLE SUMMARY TABLE				
Sample #	**Location**	**Material Description**	**Asbestos Results (% Type)**	**Is Material ACM**
S12C	ROOF 1	MEMBRANE	ND	NO
S13A	ROOF 1	TAR LAYER	ND	NO
S13B	ROOF 1	TAR LAYER	ND	NO
S13C	ROOF 1	TAR LAYER	ND	NO
S14A	ROOF 2	MEMBRANE	ND	NO
S14B	ROOF 2	MEMBRANE	ND	NO
S14C	ROOF 2	MEMBRANE	ND	NO
S15A	ROOF 2	TAR LAYER	ND	NO
S15B	ROOF 2	TAR LAYER	ND	NO
S15C	ROOF 2	TAR LAYER	ND	NO
S16A	ROOF 3	MEMBRANE	ND	NO
S16B	ROOF 3	MEMBRANE	ND	NO

TABLE 4.1: BULK ASBESTOS SAMPLE SUMMARY TABLE				
Sample #	**Location**	**Material Description**	**Asbestos Results (% Type)**	**Is Material ACM**
S16C	ROOF 3	MEMBRANE	ND	NO
S17A	ROOF 3	TAR LAYER	ND	NO
S17B	ROOF 3	TAR LAYER	<MDL	NO
S17C	ROOF 3	TAR LAYER	ND	NO
S18A	ROOF 4	MEMBRANE	ND	NO
S18B	ROOF 4	MEMBRANE	ND	NO
S18C	ROOF 4	MEMBRANE	ND	NO
S19A	ROOF 5	MEMBRANE	ND	NO
S19B	ROOF 5	MEMBRANE	ND	NO
S19C	ROOF 5	MEMBRANE	ND	NO

NA: Not Analyzed due to stop positive method **ND**: No asbestos fibres detected above the laboratory minimum detection limit

A bulk material sample containing 0.5% or more asbestos therefore establishes that material as asbestos-containing. In accordance with Table 1 of O. Reg. 278/05, a minimum number of samples for the material to be classified as non asbestos. A homogeneous material is defined by O. Reg. 278/05 “as material that is uniform in colour and texture”. Homogeneous samples are identified by an alphabetical suffix to sample names to represent multiple samples of a homogeneous material. When a homogeneous material is analysed it is determined to be asbestos-containing upon the first positive detection of asbestos equal to or greater than 0.5%. Subsequent samples of the same material are therefore not analysed. Some bulk samples are comprised of multiple layers and as such will require multiple analysis. In such cases each layer is isolated at the laboratory and analysed individually to determine asbestos content. As a result the laboratory may report additional samples beyond the submitted number of samples or include multiple analyses as subsets within a sample.

TABLE 4.2: LEAD IN PAINT SAMPLE SUMMARY TABLE					
Sample #	**Location**	**Colour**	**Material**	**Lead Content (ug/g)**	**Classification**
LP1	CORRIDOR	WHITE	WALL	309	LOW LEVEL LEAD-CONTAINING
LP2	CLASSROOM 127	PEACH	WALL	13	LOW LEVEL LEAD-CONTAINING
LP3	STAFF ROOM KITCHEN	GREEN	WALL	148	LOW LEVEL LEAD-CONTAINING
LP4	GYMNASIUM	LIGHT GREY	WALL	<5	LOW LEVEL LEAD-CONTAINING
LP5	CORRIDOR	GREY	WALL	150	LOW LEVEL LEAD-CONTAINING
LP6	2ND FLOOR MECHANICAL ROOM	GREEN	WALL	117	LOW LEVEL LEAD-CONTAINING
LP7	ROOF	YELLOW	GAS LINES	10	LOW LEVEL LEAD-CONTAINING

"<": The samples analysed reported concentrations of lead to be less than 1000 ug/g and are therefore classified as low level lead-containing. However, no lead concentrations were reported above the sample specific laboratory detection limit.

As outlined in EACO's Lead Guideline for Construction, Renovation, Maintenance or Repair (October 2014), for the purpose of classifying surface coatings and mortars by laboratory analysis, any material containing lead at a concentration:

- Greater than 0.5% by weight (5,000 µg/g, mg/kg, ppm) is considered lead-based;
- Between 0.1 % and 0.5% by weight (1,000 to 5,000 µg/g, mg/kg, ppm) is considered lead-containing; or
- Less than 0.1% (1,000 µg/g, mg/kg, ppm) is considered low level lead-containing.

Table 4.3 - Summary of Designated Substances and Recommended Actions

450 Sanatorium Road, Hamilton, Ontario

Material	Location(s)	Material Description	Management Requirements If No Impacts to Material	Recommended Actions If Material Will Be Or Likely Be Impacted By Maintenance, Renovation, Construction or Demolition Activities
Asbestos Friable	Gymnasium (143), Gymnasium Storage (143C), 2nd Floor Mechanical Room (206A)	Insulation on Pipe Fittings	In place management in accordance with O. Reg. 278/05	Removal in accordance with O. Reg. 278/05 < $1m^2$ as a Type 2 or Type 2 Glove Bag Operation and for > $1m^2$ as a Type 2 Glove Bag or Type 3 Operation
Asbestos Non-Friable	Staff Room Kitchen (130)	Drywall Ceiling	In place management in accordance with O. Reg. 278/05	Removal in accordance with O. Reg. 278/05 < $1m^2$ as a Type 1 Operation and for > $1m^2$ as a Type 2 Operation - Hand tools only in conjunction with dust suppression
Asbestos Non-Friable	Gymnasium Storage (143C)	Vinyl Floor Tiles and Associated Mastic	In place management in accordance with O. Reg. 278/05	Removal in accordance with O. Reg. 278/05 Type 1 Operation - Hand tools only in conjunction with dust suppression, or Type 2 Operation - Power tools with HEPA-filter attachment
Low Level Lead-Containing Paint	Corridor	White Paint on Walls	None	General hygiene procedures during renovation activities: • General dust control, • Washing of hands and face at on-site facilities, • No smoking, eating, chewing gum or drinking in the work area, • No abrasive blasting.
	Classroom 127	Peach paint on Walls		
	Staff Room Kitchen	Green Paint on Walls		
	Gymnasium	Light Grey on Walls		
	Corridor	Grey Paint on Walls		
	2nd Floor Mechanical Room	Green Paint on Walls		
	Roof	Yellow Paint on Gas Lines		
Lead	Throughout Interior of Building on Plumbing Connections	Lead Solder on Copper Pipe	In place management in accordance with EACC's Lead Guideline	Removal prior to renovation/demolition activities in accordance with EACC's Lead Guideline as a: Class 1 Operation

Table 4.3 - Summary of Designated Substances and Recommended Actions				
450 Sanatorium Road, Hamilton, Ontario				
Material	**Location(s)**	**Material Description**	**Management Requirements If No Impacts to Material**	**Recommended Actions If Material Will Be Or Likely Be Impacted By Maintenance, Renovation, Construction or Demolition Activities**
Mercury	Throughout Interior of Building in Light Fixtures	Fluorescent Light Tubes in Light Fixtures	None	Intact removal and storage with no on-site crushing and disposal of materials to a licensed facility
Silica	Throughout Interior and Exterior of Building	Brick and Mortar, Terrazzo	None	Conduct any work during renovation, demolition activities in accordance with the Ministry of Labour Guideline Silica on Construction Projects
Potentially Concealed PCBs	Light Fixtures Throughout	Fluorescent Light Ballasts in Light Fixtures	SOR/2008-273, the PCB Regulations, permits continued use of in-service PCB-containing light ballasts until the end of service life or until December 31, 2025	Assume each ballast contains PCBs and allow for appropriate storage and disposal in accordance with SOR/2008-273
ODS	Roof	Rooftop Air Conditioning Unit(s)	None	Assume equipment contains ODSs - prior to removal and disposal, a licensed technician shall drain and tag the equipment in a manner authorized under O. Reg. 463/10

Notes:
1) A copy of this report should be provided to all prospective contractors prior to quotation, in accordance with Section 30 of the Occupational Health and Safety Act.
2) Recommended actions are the minimum required actions, as prescribed by the appropriate Acts, regulations, guidelines, standards, codes and general best practice measures. Prior to demolition, the Contractor may choose to alter the approach and combine or break out sections of work. This is acceptable provided that the appropriate Acts, regulations, guidelines, standards and codes are followed and afford protection for the health and safety of workers, occupants and the public that is at least equal to the protection that would be provided by complying with the minimum requirements.
3) All waste generated is subject to characterization and disposal in accordance with Ontario Regulation 347.

Appendix B

Laboratory Certificates of Analysis

PARACEL LABORATORIES LTD.
TRUSTED. RESPONSIVE. RELIABLE.

15 - 6800 Kitimat Rd
Mississauga, ON, L5N 5M1
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

MTE Consultants Inc. (Burlington)

1016 Sutton Drive, Unit A
Burlington, ON L7L 6B8
Attn: Gavin Oakes

Client PO:
Project: 60595_001 - Holbrook Gym Reno DSA
Custody:

Report Date: 3-Jan-2025
Order Date: 23-Dec-2024

Order #: 2452020

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2452020-01.1	S01A - 12x12 - Blue VFT - Gymnasium
2452020-01.2	S01A - 12x12 - Blue VFT - Gymnasium
2452020-02.1	S01B - 12x12 - Blue VFT - Gymnasium
2452020-02.2	S01B - 12x12 - Blue VFT - Gymnasium
2452020-03.1	S01C - 12x12 - Blue VFT - Gymnasium
2452020-03.2	S01C - 12x12 - Blue VFT - Gymnasium
2452020-04	S02A - Plaster - Gymnasium
2452020-05	S02B - Plaster - Gymnasium
2452020-06	S02C - Plaster - Gymnasium
2452020-07	S03A - Concrete Block Mortar
2452020-08	S03B - Concrete Block Mortar
2452020-09	S03C - Concrete Block Mortar
2452020-10	S03D - Concrete Block Mortar
2452020-11	S03E - Concrete Block Mortar
2452020-12	S04A - 2x2 CT - Random Fissure
2452020-13	S04B - 2x2 CT - Random Fissure
2452020-14	S04C - 2x2 CT - Random Fissure
2452020-15	S05A - DWJC - Staff Room Ceiling
2452020-16	S05B - DWJC - Staff Room Ceiling
2452020-17	S05C - DWJC - Staff Room Ceiling
2452020-18	S06A - 2x4 - Small Fissure Random Pin CT
2452020-19	S06B - 2x4 - Small Fissure Random Pin CT
2452020-20	S06C - 2x4 - Small Fissure Random Pin CT
2452020-21	S07A - Pipe Elbows
2452020-22	S07B - Pipe Elbows
2452020-23	S07C - Pipe Elbows

Approved By:

Heather S.H. McGregor, BSc

Laboratory Director - Microbiology

2452020-24.1	S08A - 12x12 VFT - Green - 131
2452020-24.2	S08A - 12x12 VFT - Green - 131
2452020-25.1	S08B - 12x12 VFT - Green - 131
2452020-25.2	S08B - 12x12 VFT - Green - 131
2452020-26.1	S08C - 12x12 VFT - Green - 131
2452020-26.2	S08C - 12x12 VFT - Green - 131
2452020-27	S09A - Roof Flashing Sealant
2452020-28	S09B - Roof Flashing Sealant
2452020-29	S09C - Roof Flashing Sealant
2452020-30.1	S10A - Roof Mechanical Sealant
2452020-30.2	S10A - Roof Mechanical Sealant
2452020-31.1	S10B - Roof Mechanical Sealant
2452020-31.2	S10B - Roof Mechanical Sealant
2452020-32.1	S10C - Roof Mechanical Sealant
2452020-32.2	S10C - Roof Mechanical Sealant
2452020-33	S11A - Exterior Brick Mortar
2452020-34	S11B - Exterior Brick Mortar
2452020-35	S11C - Exterior Brick Mortar
2452020-36	S11D - Exterior Brick Mortar
2452020-37	S11E - Exterior Brick Mortar
2452020-38	S12A - Roof 1 - Membrane
2452020-39	S12B - Roof 1 - Membrane
2452020-40	S12C - Roof 1 - Membrane
2452020-41	S13A - Roof 1 - Tar Layer
2452020-42	S13B - Roof 1 - Tar Layer
2452020-43	S13C - Roof 1 - Tar Layer
2452020-44	S14A - Roof 2 - Membrane
2452020-45	S14B - Roof 2 - Membrane
2452020-46	S14C - Roof 2 - Membrane
2452020-47	S15A - Roof 2 - Membrane
2452020-48	S15B - Roof 2 - Membrane
2452020-49	S15C - Roof 2 - Membrane
2452020-50	S16A - Roof 3 - Membrane
2452020-51	S16B - Roof 3 - Membrane
2452020-52	S16C - Roof 3 - Membrane
2452020-53	S17A - Roof 3 - Tar Layer
2452020-54	S17B - Roof 3 - Tar Layer
2452020-55	S17C - Roof 3 - Tar Layer
2452020-56	S18A - Roof 4 - Membrane
2452020-57	S18B - Roof 4 - Membrane
2452020-58	S18C - Roof 4 - Membrane
2452020-59	S19A - Roof 5 - Membrane
2452020-60	S19B - Roof 5 - Membrane
2452020-61	S19C - Roof 5 - Membrane

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2452020-01.1	18-Dec-24	Blue	Vinyl Floor Tile	No	**Client ID: S01A - 12x12 - Blue VFT - Gymnasium**	
					Non-Fibers	100
2452020-01.2	18-Dec-24	Black	Mastic	No	**Client ID: S01A - 12x12 - Blue VFT - Gymnasium**	
					Non-Fibers	100
2452020-02.1	18-Dec-24	Blue	Vinyl Floor Tile	No	**Client ID: S01B - 12x12 - Blue VFT - Gymnasium**	
					Non-Fibers	100
2452020-02.2	18-Dec-24	Black	Mastic	No	**Client ID: S01B - 12x12 - Blue VFT - Gymnasium**	
					Non-Fibers	100
2452020-03.1	18-Dec-24	Blue	Vinyl Floor Tile	No	**Client ID: S01C - 12x12 - Blue VFT - Gymnasium**	
					Non-Fibers	100
2452020-03.2	18-Dec-24	Black	Mastic	No	**Client ID: S01C - 12x12 - Blue VFT - Gymnasium**	
					Non-Fibers	100
2452020-04	18-Dec-24	White/Grey	Plaster	No	**Client ID: S02A - Plaster - Gymnasium** [AS-LR-NA]	
					Non-Fibers	100
2452020-05	18-Dec-24	White/Grey	Plaster	No	**Client ID: S02B - Plaster - Gymnasium** [AS-LR-NA]	
					Non-Fibers	100
2452020-06	18-Dec-24	White/Grey	Plaster	No	**Client ID: S02C - Plaster - Gymnasium** [AS-LR-NA]	
					Non-Fibers	100
2452020-07	18-Dec-24	Grey	Mortar	No	**Client ID: S03A - Concrete Block Mortar**	
					Non-Fibers	100
2452020-08	18-Dec-24	Grey	Mortar	No	**Client ID: S03B - Concrete Block Mortar**	
					Non-Fibers	100
2452020-09	18-Dec-24	Grey	Mortar	No	**Client ID: S03C - Concrete Block Mortar**	
					Non-Fibers	100
2452020-10	18-Dec-24	Grey	Mortar	No	**Client ID: S03D - Concrete Block Mortar**	
					Non-Fibers	100

Certificate of Analysis

Report Date: 03-Jan-2025

Client: MTE Consultants Inc. (Burlington)

Order Date: 23-Dec-2024

Client PO:

Project Description: 60595_001 - Holbrook Gym Reno DSA

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2452020-11	18-Dec-24	Grey	Mortar	No	**Client ID: S03E - Concrete Block Mortar**	
					Non-Fibers	100
2452020-12	18-Dec-24	Grey	Ceiling Tile	No	**Client ID: S04A - 2x2 CT - Random Fissure**	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2452020-13	18-Dec-24	Grey	Ceiling Tile	No	**Client ID: S04B - 2x2 CT - Random Fissure**	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2452020-14	18-Dec-24	Grey	Ceiling Tile	No	**Client ID: S04C - 2x2 CT - Random Fissure**	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2452020-15	18-Dec-24	Beige	Drywall Joint Compound	**Yes**	**Client ID: S05A - DWJC - Staff Room Ceiling**	
					Chrysotile	2
					Non-Fibers	98
2452020-16	18-Dec-24	Beige	Drywall Joint Compound		**Client ID: S05B - DWJC - Staff Room Ceiling**	
					not analyzed, positive stop	
2452020-17	18-Dec-24	Beige	Drywall Joint Compound		**Client ID: S05C - DWJC - Staff Room Ceiling**	
					not analyzed, positive stop	
2452020-18	18-Dec-24	Grey	Ceiling Tile	No	**Client ID: S06A - 2x4 - Small Fissure Random Pin CT**	
					Cellulose	40
					MMVF	30
					Non-Fibers	30
2452020-19	18-Dec-24	Grey	Ceiling Tile	No	**Client ID: S06B - 2x4 - Small Fissure Random Pin CT**	
					Cellulose	40
					MMVF	30
					Non-Fibers	30

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected		Material Identification	% Content
2452020-20	18-Dec-24	Grey	Ceiling Tile	No		**Client ID: S06C - 2x4 - Small Fissure Random Pin CT**	
						Cellulose	40
						MMVF	30
						Non-Fibers	30
2452020-21	18-Dec-24	Grey	Pipe Elbow	**Yes**		**Client ID: S07A - Pipe Elbows**	
						Chrysotile	60
						Non-Fibers	40
2452020-22	18-Dec-24	Grey	Pipe Elbow			**Client ID: S07B - Pipe Elbows**	
						not analyzed, positive stop	
2452020-23	18-Dec-24	Grey	Pipe Elbow			**Client ID: S07C - Pipe Elbows**	
						not analyzed, positive stop	
2452020-24.1	18-Dec-24	Green	Vinyl Floor Tile	No		**Client ID: S08A - 12x12 VFT - Green - 131**	
						Non-Fibers	100
2452020-24.2	18-Dec-24	Black	Mastic	**Yes**		**Client ID: S08A - 12x12 VFT - Green - 131** [AS-PT]	
					[ASTrc]	**Chrysotile**	<MDL
						Non-Fibers	100
2452020-25.1	18-Dec-24	Green	Vinyl Floor Tile	No		**Client ID: S08B - 12x12 VFT - Green - 131**	
						Non-Fibers	100
2452020-25.2	18-Dec-24	Black	Mastic	**Yes**		**Client ID: S08B - 12x12 VFT - Green - 131** [AS-PT]	
					[ASTrc]	**Chrysotile**	<MDL
						Non-Fibers	100
2452020-26.1	18-Dec-24	Green	Vinyl Floor Tile	No		**Client ID: S08C - 12x12 VFT - Green - 131**	
						Non-Fibers	100
2452020-26.2	18-Dec-24	Black	Mastic	**Yes**		**Client ID: S08C - 12x12 VFT - Green - 131** [AS-PT]	
					[ASTrc]	**Chrysotile**	<MDL
						Non-Fibers	100
2452020-27	18-Dec-24	Grey	Sealant	No		**Client ID: S09A - Roof Flashing Sealant**	
						Non-Fibers	100

Certificate of Analysis

Report Date: 03-Jan-2025

Client: MTE Consultants Inc. (Burlington)

Order Date: 23-Dec-2024

Client PO:

Project Description: 60595_001 - Holbrook Gym Reno DSA

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2452020-28	18-Dec-24	Grey	Sealant	No	**Client ID: S09B - Roof Flashing Sealant**	
					Non-Fibers	100
2452020-29	18-Dec-24	Grey	Sealant	No	**Client ID: S09C - Roof Flashing Sealant**	
					Non-Fibers	100
2452020-30.1	18-Dec-24	Brown	Sealant	No	**Client ID: S10A - Roof Mechanical Sealant**	
					Non-Fibers	100
2452020-30.2	18-Dec-24	Grey	Sealant	No	**Client ID: S10A - Roof Mechanical Sealant**	
					Non-Fibers	100
2452020-31.1	18-Dec-24	Brown	Sealant	No	**Client ID: S10B - Roof Mechanical Sealant**	
					Non-Fibers	100
2452020-31.2	18-Dec-24	Grey	Sealant	No	**Client ID: S10B - Roof Mechanical Sealant**	
					Non-Fibers	100
2452020-32.1	18-Dec-24	Brown	Sealant	No	**Client ID: S10C - Roof Mechanical Sealant**	
					Non-Fibers	100
2452020-32.2	18-Dec-24	Grey	Sealant	No	**Client ID: S10C - Roof Mechanical Sealant**	
					Non-Fibers	100
2452020-33	18-Dec-24	Grey	Mortar	No	**Client ID: S11A - Exterior Brick Mortar**	
					Non-Fibers	100
2452020-34	18-Dec-24	Grey	Mortar	No	**Client ID: S11B - Exterior Brick Mortar**	
					Non-Fibers	100
2452020-35	18-Dec-24	Grey	Mortar	No	**Client ID: S11C - Exterior Brick Mortar**	
					Non-Fibers	100
2452020-36	18-Dec-24	Grey	Mortar	No	**Client ID: S11D - Exterior Brick Mortar**	
					Non-Fibers	100
2452020-37	18-Dec-24	Grey	Mortar	No	**Client ID: S11E - Exterior Brick Mortar**	
					Non-Fibers	100

Certificate of Analysis

Report Date: 03-Jan-2025

Client: **MTE Consultants Inc. (Burlington)**

Order Date: 23-Dec-2024

Client PO:

Project Description: 60595_001 - Holbrook Gym Reno DSA

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2452020-38	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S12A - Roof 1 - Membrane** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90
2452020-39	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S12B - Roof 1 - Membrane** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90
2452020-40	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S12C - Roof 1 - Membrane** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90
2452020-41	18-Dec-24	Black	Tar	No	**Client ID: S13A - Roof 1 - Tar Layer** [AS-PRE]	
					Cellulose	10
					MMVF	5
					Non-Fibers	85
2452020-42	18-Dec-24	Black	Tar	No	**Client ID: S13B - Roof 1 - Tar Layer** [AS-PRE]	
					Cellulose	10
					MMVF	5
					Non-Fibers	85
2452020-43	18-Dec-24	Black	Tar	No	**Client ID: S13C - Roof 1 - Tar Layer** [AS-PRE]	
					Cellulose	10
					MMVF	5
					Non-Fibers	85
2452020-44	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S14A - Roof 2 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	5
					Non-Fibers	85
2452020-45	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S14B - Roof 2 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	5
					Non-Fibers	85

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2452020-46	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S14C - Roof 2 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	5
					Non-Fibers	85
2452020-47	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S15A - Roof 2 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	15
					Non-Fibers	75
2452020-48	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S15B - Roof 2 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	15
					Non-Fibers	75
2452020-49	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S15C - Roof 2 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	15
					Non-Fibers	75
2452020-50	18-Dec-24	Black	Roofing Membane	No	**Client ID: S16A - Roof 3 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	10
					Non-Fibers	80
2452020-51	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S16B - Roof 3 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	10
					Non-Fibers	80
2452020-52	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S16C - Roof 3 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	10
					Non-Fibers	80
2452020-53	18-Dec-24	Black	Tar	No	**Client ID: S17A - Roof 3 - Tar Layer** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90

Certificate of Analysis

Report Date: 03-Jan-2025

Client: **MTE Consultants Inc. (Burlington)**

Order Date: 23-Dec-2024

Client PO:

Project Description: 60595_001 - Holbrook Gym Reno DSA

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel ID	Sample Date	Colour	Description	Asbestos Detected	Material Identification	% Content
2452020-54	18-Dec-24	Black	Tar	**Yes**	**Client ID: S17B - Roof 3 - Tar Layer** [AS-PRE, AS-PT]	
				[ASTrc]	**Chrysotile**	<MDL
					Cellulose	10
					Non-Fibers	90
2452020-55	18-Dec-24	Black	Tar	No	**Client ID: S17C - Roof 3 - Tar Layer** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90
2452020-56	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S18A - Roof 4 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	10
					Non-Fibers	80
2452020-57	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S18B - Roof 4 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	10
					Non-Fibers	80
2452020-58	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S18C - Roof 4 - Membrane** [AS-PRE]	
					Cellulose	10
					MMVF	10
					Non-Fibers	80
2452020-59	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S19A - Roof 5 - Membrane** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90
2452020-60	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S19B - Roof 5 - Membrane** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90
2452020-61	18-Dec-24	Black	Roofing Membrane	No	**Client ID: S19C - Roof 5 - Membrane** [AS-PRE]	
					Cellulose	10
					Non-Fibers	90

* MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool

**** Analytes in bold indicate asbestos mineral content.**

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	Lab Accreditation	Analysis Date
Asbestos, PLM Visual Estimation	AppE to SubE of 40CFR Part763 and EPA/600/R-93/116	1 - Mississauga	CALA 3762	2-Jan-25

Mississauga Lab: 15 - 6800 Kitimat Rd Mississauga, Ontario, L5N 5M1

Qualifier Notes

Sample Qualifiers :

AS-LR-NA:	Layers/materials inseparable, combined and not analysed separately
AS-PRE:	Due to the difficult nature of the bulk sample (interfering fibers/binders), additional NOB preparation was required prior to analysis
AS-PT:	Asbestos quantitation by PLM Point Count method.
ASTrc:	Trace asbestos was observed below the noted detection limit but could not be accurately quantified.

Work Order Revisions | Comments

None

PARACEL LABORATORIES LTD.

Paracel ID: 2452020

ce
St. Laurent Blvd.
ntario K1G 4J8
49-1947
aparacellabs.com

Chain of Custody
(Lab Use Only)

Client Name: MTE Consultants		Project Reference: 60595_001 - Holbrook Gym Reno DSA	**Turnaround Time:**
Contact Name: Gavin Oakes; Aaron Rows		Quote #: MTE Standing Offer	☐ Immediate ☐ 1 Day
Address: 1016 Sutton Drive, Unit A		PO #:	☐ 4 Hour ☐ 2 Day
Burlington, ON L7L 6B8		Email Address: goakes@mte85.com	☐ 8 Hour ☐ 3 Day
Telephone: 905-639-2552		arows@mte85.com	☒ Regular
			Date Required:

ASBESTOS & MOLD ANALYSIS

Matrix: ☐ Air ☒ Bulk ☐ Tape Lift ☐ Swab ☐ Other **Regulatory Guideline:** ☒ ON ☐ QC ☐ AB ☐ SK ☐ Other:

Analyses: ☐ Microscopic Mold ☐ Culturable Mold ☐ Bacteria GRAM ☐ PCM Asbestos ☒ PLM Asbestos ☐ Chatfield Asbestos ☐ TEM Asbestos

Paracel Order Number: 2452020

	Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Asbestos - Bulk: Identify Distinct Building Materials to Be Analyzed (if not specified, all materials identified will be analyzed) *	Asbestos - Bulk: Positive Stop?
1	S01 A-C - 12"x12" - Blue VFT - Gymnasium	18 Dec 24	-	PLM		☒
2	S02 A-C - Plaster - Gymnasium	18 Dec 24	-	PLM		☒
3	S03 A-E - Concrete Block Mortar	18 Dec 24	-	PLM		☒
4	S04 A-C - 2'x2' CT - Random Fissure	18 Dec 24	-	PLM		☒
5	S05 A-C - DWJC - Staff Room Ceiling	18 Dec 24	-	PLM		☒
6	S06 A-C - 2'x4' - Small Fissure Random Pin CT	18 Dec 24	-	PLM		☒
7	S07 A-C - Pipe Elbows	18 Dec 24	-	PLM		☒
8	S08 A-C - 12"x12" VFT - Green - 131	18 Dec 24	-	PLM		☒
9	S09 A-C - Roof Flashing Sealant	18 Dec 24	-	PLM		☒
10	S10 A-C - Roof Mechanical Sealant	18 Dec 24	-	PLM		☒
11	S11 A-E - Exterior Brick Mortar	18 Dec 24	-	PLM		☒
12	S12 A-C - Roof 1 - Membrane	18 Dec 24	-	PLM		☒

* If left blank, all distinct materials identified in the samples will be analyzed and reported separately as per EPA 600/R-93/116. Additional charges will apply.

Comments:

Method of Delivery: Purolator

Relinquished By (Sign):	Received at Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Aaron Rows			
Date/Time: 19 Dec 24 - 11:30 am	Date/Time:	Date/Time: Dec 23/24 9:30	Date/Time: Dec 23/24 9:33

PARACEL LABORATORIES LTD

Paracel ID: 2452020

ead Office
0-2319 St. Laurent Blvd.
tawa, Ontario K1G 4J8
1-800-749-1947
paracel@paracellabs.com

Chain of Custody
(Lab Use Only)

Page 2 of 2

Client Name: MTE Consultants	Project Reference: 60595_001 - Holbrook Gym Reno DSA
Contact Name: Gavin Oakes; Aaron Rows	Quote #: MTE Standing Offer
Address: 1016 Sutton Drive, Unit A Burlington, ON L7L 6B8	PO #:
Telephone: 905-639-2552	Email Address: goakes@mte85.com arows@mte85.com

Turnaround Time:

- ☐ Immediate
- ☐ 4 Hour
- ☐ 8 Hour
- ☐ 1 Day
- ☐ 2 Day
- ☐ 3 Day
- ☒ Regular

Date Required: _____

ASBESTOS & MOLD ANALYSIS

Matrix: ☐ Air ☒ Bulk ☐ Tape Lift ☐ Swab ☐ Other **Regulatory Guideline:** ☒ ON ☐ QC ☐ AB ☐ SK ☐ Other:

Analyses: ☐ Microscopic Mold ☐ Culturable Mold ☐ Bacteria GRAM ☐ PCM Asbestos ☒ PLM Asbestos ☐ Chatfield Asbestos ☐ TEM Asbestos

Paracel Order Number: 2452020

	Sample ID	Sampling Date	Air Volume (L)	Analysis Required	Asbestos - Bulk: Identify Distinct Building Materials to Be Analyzed (if not specified, all materials identified will be analyzed) *	Asbestos - Bulk: Positive Stop?
1	S13 A-C - Roof 1 - Tar Layer	18 Dec 24	-	PLM		☒
2	S14 A-C - Roof 2 - Membrane	18 Dec 24	-	PLM		☒
3	S15 A-C - Roof 2 - Membrane	18 Dec 24	-	PLM		☒
4	S16 A-C - Roof 3 - Membrane	18 Dec 24	-	PLM		☒
5	S17 A-C - Roof 3 - Tar Layer	18 Dec 24	-	PLM		☒
6	S18 A-C - Roof 4 - Membrane	18 Dec 24	-	PLM		☒
7	S19 A-C - Roof 5 - Membrane	18 Dec 24	-	PLM		☒
8						☒
9						☐
10						☐
11						☐
12						☐

* If left blank, all distinct materials identified in the samples will be analyzed and reported separately as per EPA 600/R-93/116. Additional charges will apply.

Comments:

Method of Delivery: Purolator

Relinquished By (Sign):	Received at Depot:	Received at Lab:	Verified By:
Relinquished By (Print):			
Date/Time:	Date/Time:	Date/Time: Dec 23/24 8:30	Date/Time: Dec 23/24 9:33

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Certificate of Analysis

MTE Consultants Inc. (Burlington)

1016 Sutton Drive, Unit A
Burlington, ON L7L 6B8
Attn: Gavin Oakes

Client PO:
Project: 60595_001 - Holbrook Gym Reno DSA
Custody:

Report Date: 5-Jan-2025
Order Date: 30-Dec-2024

Order #: 2453024

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2453024-01	LP01- White
2453024-02	LP02- Peach
2453024-03	LP03- Green
2453024-04	LP04- Light Grey
2453024-05	LP05- Grey
2453024-06	LP06- Green
2453024-07	LP07- Yellow

Approved By:

Milan Ralitsch, PhD
Senior Technical Manager

Certificate of Analysis

Report Date: 05-Jan-2025

Client: MTE Consultants Inc. (Burlington)

Order Date: 30-Dec-2024

Client PO:

Project Description: 60595_001 - Holbrook Gym Reno DSA

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Metals, ICP-MS	EPA 6020 - Digestion - ICP-MS	3-Jan-25	3-Jan-25

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions/Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Certificate of Analysis

Report Date: 05-Jan-2025

Client: MTE Consultants Inc. (Burlington)

Order Date: 30-Dec-2024

Client PO:

Project Description: 60595_001 - Holbrook Gym Reno DSA

Sample Results

Lead

Matrix: Paint

Paracel ID	Client ID	Sample Date	Units	MDL	Result
2453024-01	LP01- White	17-Dec-24	ug/g	5	309
2453024-02	LP02- Peach	17-Dec-24	ug/g	5	13
2453024-03	LP03- Green	17-Dec-24	ug/g	5	148
2453024-04	LP04- Light Grey	17-Dec-24	ug/g	5	<5
2453024-05	LP05- Grey	17-Dec-24	ug/g	5	150
2453024-06	LP06- Green	17-Dec-24	ug/g	5	117
2453024-07	LP07- Yellow	17-Dec-24	ug/g	5	10

Laboratory Internal QA/QC

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Matrix Blank									
Lead	**ND**	**5**	**ug/g**						
Matrix Duplicate									
Lead	**2390**	**5**	**ug/g**	**3030**			**23.60**	**50**	
Matrix Spike									
Lead	173	5.00	ug/g	121	104	70-130			

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Paracel ID: 2453024

rder Number
Use Only)

Chain Of Custody
(Lab Use Only)

Client Name: MTE Consultants	Project Ref: 60595_001 - Holbrook Gym Reno DSA
Contact Name: Gavin Oakes;Aaron Rows	Quote #: MTE Standing Offer
Address: 1016 Sutton Drive, Unit A Burlington, ON L7L 6B8	PO #:
Telephone: 905-639-2552	E-mail: goakes@mte85.com arows@mte85.com

Page 1 of 1

Turnaround Time

☐ 1 day ☐ 3 day
☐ 2 day ☑ Regular
Date Required: _____

☐ REG 153/04 ☐ REG 406/19

☐ Table 1 ☐ Res/Park ☐ Med/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other
☐ Table ___
For RSC: ☐ Yes ☐ No

Other Regulation

☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun: ___
☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Required Analysis: Lead
1	LP01 - white	P	-	1	17 Dec 24	3:00 pm	X
2	LP02 - Peach	P	-	1			X
3	LP03 - Green	P	-	1			X
4	LP04 - Light grey	P	-	1			X
5	LP05 - Grey	P	-	1			X
6	LP06 - Green	P	-	1			X
7	LP07 - Yellow	P	-	1	↓	↓	X
8							
9							
10							

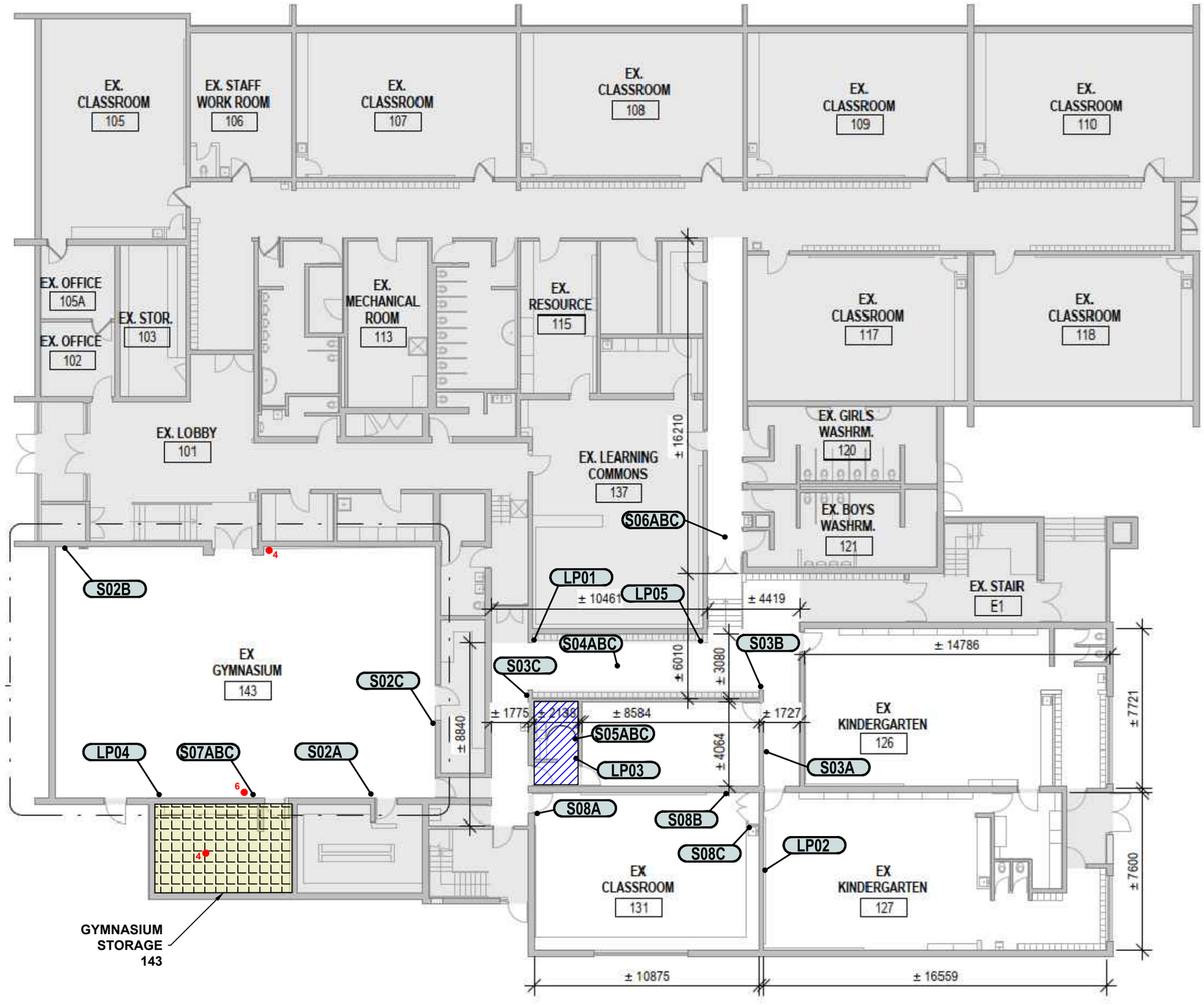
Comments:

Method of Delivery: Purolator

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab: N	Verified By: AR
Relinquished By (Print): Aaron Rows	Date/Time:	Date/Time: 12/30/24 9:15	Date/Time: 12/30/24 11:23
Date/Time: 19 Dec 24 - 11:20 am	Temperature: °C	Temperature:	pH Verified: ☐ By:

Appendix C

Figures



Notes:

ALL DRAWINGS TO BE REFERENCED WITH THE DSA REPORT. LOCATIONS AND QUANTITIES ARE APPROXIMATE.

ALL KNOWN OR SUSPECT DESIGNATED SUBSTANCES ARE NOT DEPICTED ON THIS FIGURE. REFER TO THE DSA REPORT FOR A COMPLETE LIST OF IDENTIFIED KNOWN AND SUSPECT DESIGNATED SUBSTANCES.

THIS FIGURE IS COLOUR DEPENDENT, PHOTOCOPIES MAY ALTER INTERPRETATION OF FIGURE. ALWAYS REFER TO ORIGINAL DRAWINGS AND DSA REPORT.

Designated Substances and Hazardous Materials Legend

S02CD — Sample Identification

4 — Pipe Fitting Insulation with Quantity

ACM Drywall Ceiling

ACM Tiles and Mastic

MTE
Engineers, Scientists, Surveyors
Ph. (905) 639-2552 www.mte85.com

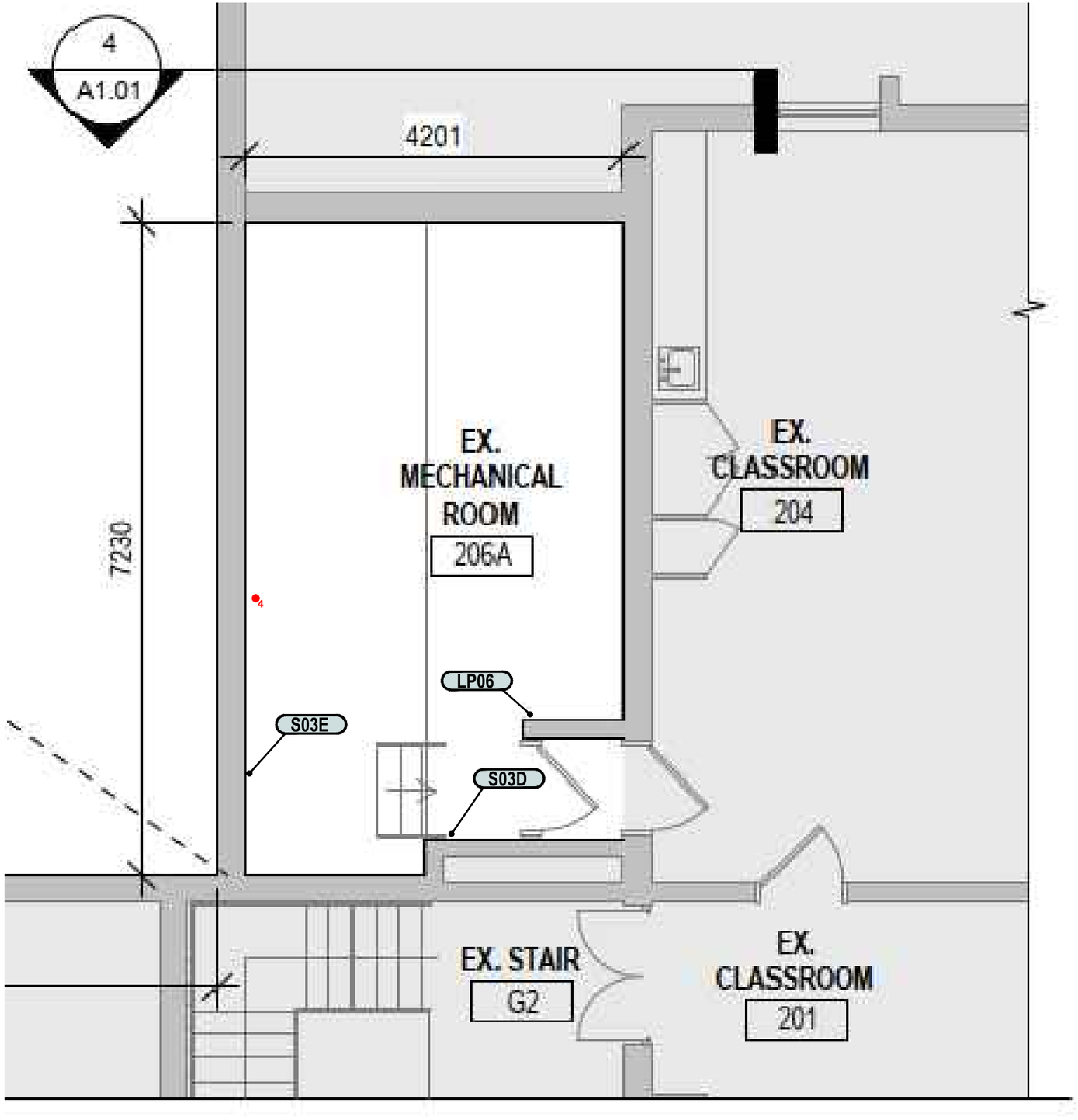
CLIENT
Hamilton-Wenworth District School Board

PROJECT
DESIGNATED SUBSTANCE AUDIT

DRAWING
MAIN FLOOR
450 SANATORIUM ROAD
HAMILTON, ONTARIO

Project Manager	G. OAKES	Date	JANUARY 2025
Baseplan By	MTE	Project No.	60595_001
Figure By	SXS	Drawing No.	1.0
Scale	N.T.S.		

January 13, 2025 — 2:00 pm — Plotted By: SXS
Project: 60595_001 CAD: P:\P\60595_001\60595_001 – DSS.DWG



Notes:

ALL DRAWINGS TO BE REFERENCED WITH THE DSA REPORT. LOCATIONS AND QUANTITIES ARE APPROXIMATE.

ALL KNOWN OR SUSPECT DESIGNATED SUBSTANCES ARE NOT DEPICTED ON THIS FIGURE. REFER TO THE DSA REPORT FOR A COMPLETE LIST OF IDENTIFIED KNOWN AND SUSPECT DESIGNATED SUBSTANCES.

THIS FIGURE IS COLOUR DEPENDENT, PHOTOCOPIES MAY ALTER INTERPRETATION OF FIGURE. ALWAYS REFER TO ORIGINAL DRAWINGS AND DSA REPORT.

Designated Substances and Hazardous Materials Legend

S02CD — Sample Identification

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Engineers, Scientists, Surveyors

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CLIENT
Hamilton-Wenworth
District School Board

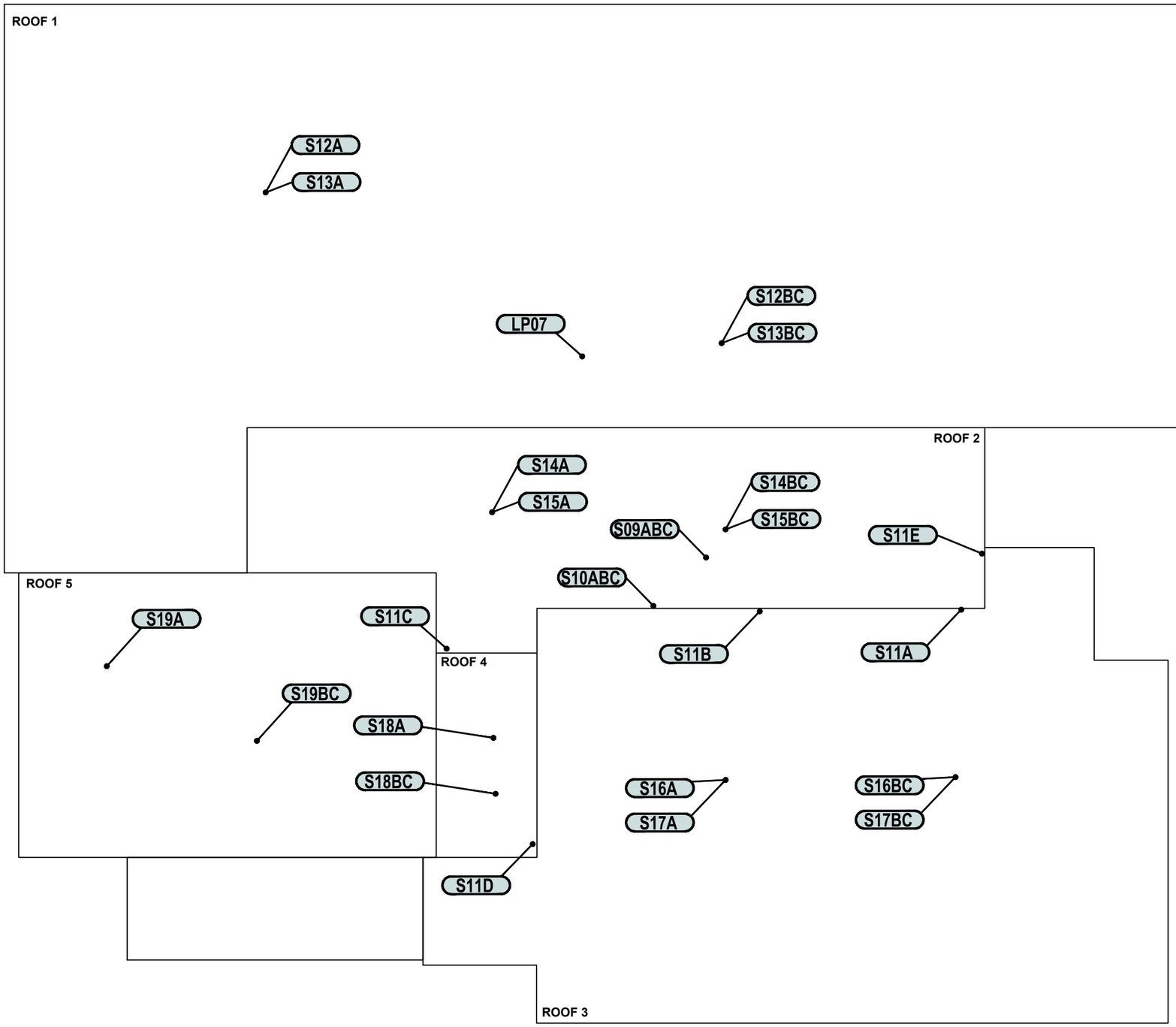
PROJECT
DESIGNATED
SUBSTANCE AUDIT

DRAWING

SECOND FLOOR
450 SANATORIUM ROAD
HAMILTON, ONTARIO

Project Manager	G. OAKES	Date	JANUARY 2025
Baseplan By	MTE	Project No.	60595_001
Figure By	SXS	Drawing No.	2.0
Scale	N.T.S.		

January 13, 2025 – 2:00 pm – Plotted By: SXS Project: 60595_001 CAD: P:\P\60595_001\60595_001– DSS.DWG



Notes:

ALL DRAWINGS TO BE REFERENCED WITH THE DSA REPORT. LOCATIONS AND QUANTITIES ARE APPROXIMATE.

ALL KNOWN OR SUSPECT DESIGNATED SUBSTANCES ARE NOT DEPICTED ON THIS FIGURE. REFER TO THE DSA REPORT FOR A COMPLETE LIST OF IDENTIFIED KNOWN AND SUSPECT DESIGNATED SUBSTANCES.

THIS FIGURE IS COLOUR DEPENDENT, PHOTOCOPIES MAY ALTER INTERPRETATION OF FIGURE. ALWAYS REFER TO ORIGINAL DRAWINGS AND DSA REPORT.

Designated Substances and Hazardous Materials Legend

S02CD — Sample Identification

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Engineers, Scientists, Surveyors
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CLIENT
Hamilton-Wenworth District School Board

PROJECT
DESIGNATED SUBSTANCE AUDIT

DRAWING
ROOF PLAN
450 SANATORIUM ROAD
HAMILTON, ONTARIO

Project Manager	G. OAKES	Date	JANUARY 2025
Baseplan By	MTE	Project No.	60595_001
Figure By	SXS	Drawing No.	3.0
Scale	N.T.S.		

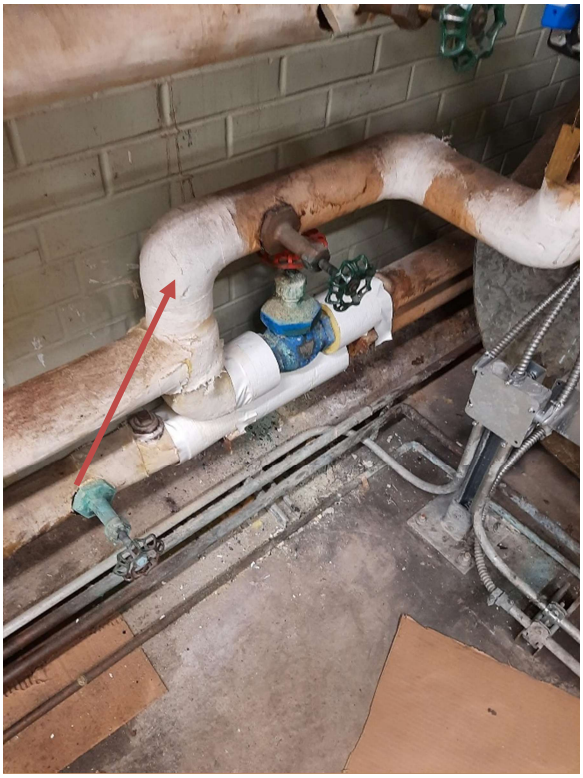
Project: 60595_001 CAD: P:\P\60595_001\60595_001- DSS.DWG — Plotted By: SXS — January 13, 2025 — 2:00 pm

Appendix D

Photographic Log

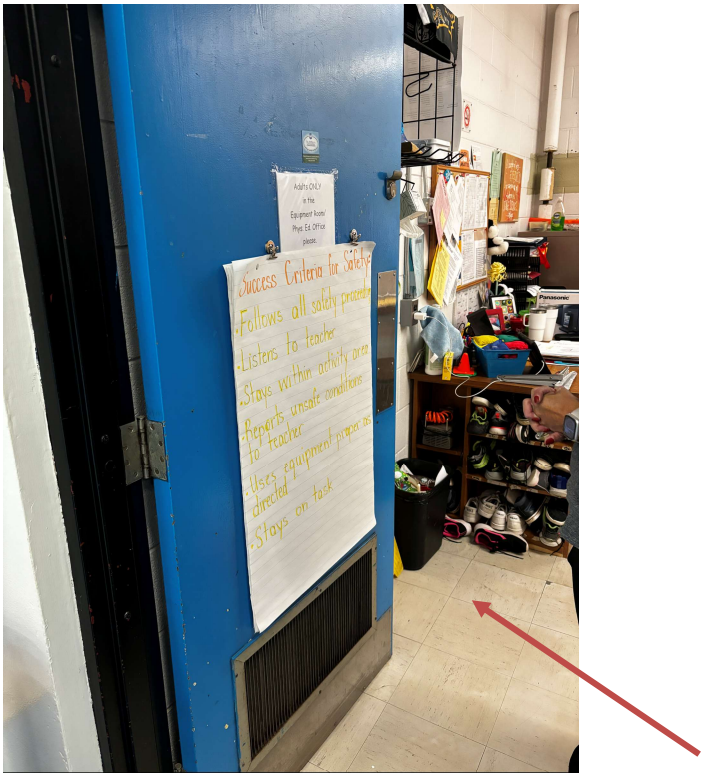
Photograph No. 1 – Drywall joint compound on the ceiling of the Staff Room Kitchen was sampled (S05A,B,C). The joint compound contains asbestos.

Photograph No. 2 – Pipe elbow insulation within the Gymnasium was sampled (S07A,B,C) and is asbestos containing. Approximately 10 fittings were observed within the area.

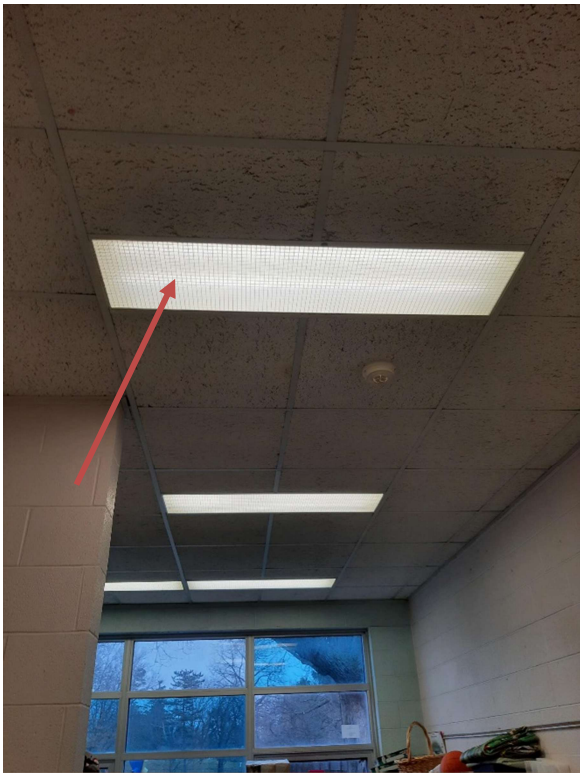


Photograph No. 3 – Asbestos-containing pipe fitting insulation was also observed in the Mechanical Room. Approximately 4 fittings were observed in the area.

Photograph No. 4 – Asbestos-containing pipe fitting insulation was also observed in the Gymnasium Storage Room. Approximately 4 fittings were observed in the area.



Photograph No. 5 – Vinyl floor tiles and associated mastic within the Gymnasium Storage Room were previously identified as asbestos-containing.



Photograph No. 6 – Mercury containing fluorescent light tubes are present throughout the building. Associated light ballasts could not be safely inspected and are assumed to contain PCBs.

Photograph No. 7 – Rooftop air handling units were observed and are assumed to contain ozone depleting substances.

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read this section in conjunction with all other sections so as to conform to Division 1, and the General Requirements of the project.

.2 Inform all sub-trades of the presence of Asbestos Containing Materials identified in the documents.

.3 The Contractor involved directly or indirectly with the removal, handling, management, transportation and disposal of Asbestos Containing Materials and Asbestos Waste in any and all aspects shall take all reasonable precautions, due care and diligence to prevent asbestos from becoming airborne and shall take all reasonable precautions to control and prevent the spread of airborne asbestos in the event of an incident, accidental release or loss of containment. Cost of additional work by the Contractor and/or Consultant to rectify unsatisfactory conditions, shall be charged to the Contractor.

.4 No allowance will be made for any difficulties encountered or any expenses incurred on account of any conditions of the site or any item existing thereon that is visible or known or can be reasonably anticipated.

.5 The Contractor shall be prepared to respond throughout the duration of the project in order to repair, encapsulate remove or otherwise manage additional asbestos as required. The abatement contractor shall provide an emergency contact phone number and be on call to provide emergency services.

.6 The abatement contractor shall control all water migration (including leakage and spillage) from the abatement work area to areas below/adjacent. It is the responsibility of the contractor to protect all items from damage caused by water used in the abatement work area(s). The abatement contractor must immediately mitigate any and all damage to the satisfaction of the owner and Consultant resulting from water used in the abatement work area(s) at their own expense. No allowances shall be made as a result of lost time, resources, materials or equipment.

.7 It is the Contractor’s responsibility to ensure all construction aspects of the project are conducted in accordance with applicable construction safety legislation, regulations and general approved practice. This includes, but is not limited to; all means, methods, techniques, sequences, procedures, safety programs and precautions used.

1.2 DEFINITIONS

.1 Asbestos Containing Material: Materials that contain 0.5 percent or more asbestos by dry weight.

.2 Asbestos Waste: is material that contains asbestos in more than a trivial amount or proportion as defined by Ontario Regulation 347 as amended by Ontario Regulation 558/00 and includes the following:

.1 Solid or liquid waste that results from the removal of asbestos-containing construction or insulation materials and contains asbestos;

.2 Commercial waste and/or domestic waste that contains asbestos;

.3 Non-hazardous solid industrial waste that contains asbestos; and

.4 Materials determined or deemed contaminated with asbestos.

.3 Authorized Visitors: The Consultant or their representative, Architect, Owner's representatives, and persons representing regulatory agencies.

.4 Contractor: Contractors or Sub-Contractor performing work included in this specification.

.5 Consultant: Owner's Representative providing inspection and air monitoring.

MTE Consultants Inc.
1016 Sutton Drive, Unit A, Burlington, Ontario, L7L 6B8
Phone: 905-639-2552 Fax: 905-639-7727
Contact: Gavin Oakes Cell: 905-719-5217

PART 2 – SCOPE OF WORK

2.1 SUMMARY OF MATERIALS

.1 Refer to the following documents regarding Designated Substances within the work areas. The survey and documentation of Designated Substances is required by Section 30 of the Occupational Health and Safety Act and shall be read in conjunction with these specifications. Management of these materials shall be included in the base bid price.

.1 "*Designated Substance Audit Report – Holbrook Elementary School Gym Renovations & AHU Replacement, 450 Sanatorium Road, Hamilton, ON*" dated January 29, 2025 (revised January 30, 2025) prepared by MTE Consultants Inc.

.2 Removal and/or disturbance of asbestos-containing materials shall be performed in accordance with Ontario Regulation 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations.

.3 Removal and/or disturbance of lead-based and lead-containing materials shall be performed in accordance with the Environmental Abatement Council of Canada's Lead Guideline for Construction, Renovation, Maintenance and Repair (2014)

.4 Removal and/or disturbance of mercury-containing materials shall be performed in a manner which maintains the mercury intact, with no on-site crushing. Following removal, mercury-containing materials shall be safely stored on-Site until the Contractor can safely dispose of the materials at a licensed landfill.

.5 Removal and/or disturbance of silica-containing materials shall be performed in accordance with the Ministry of Labour's Guideline Silica on Construction Projects.

.6 Suspect PCB-containing equipment, including light ballasts, shall be assumed to contain PCBs and included for proper storage and disposal. All PCB-containing, equipment shall be appropriately stored and disposed of by the Contractor in accordance with SOR 2008-273 - PCB Regulations.

.7 Suspect ODS-containing equipment shall be assumed to contain ODS's and shall be drained, tagged and disposed of by a licensed technician in accordance with Ontario Regulation 463/10.

.2 ACM may be present in concealed locations and become apparent during construction, renovation, alteration, or maintenance activities. Should any suspect ACM be discovered during the course of regular construction, renovation, alteration, or maintenance activities, work should cease and the materials should not be disturbed. Suspect ACM must be treated as asbestos-containing or sampled and proven to not contain asbestos. Any activities that require disturbance of ACM must be performed in accordance with Ontario Regulation 278/05. It is the responsibility of the constructor to provide supervision and training and undertake due care and diligence in situations where such discoveries can and would occur.

.3 Upon discovery of suspect or known ACM not identified or referred to in Section 2.0 or the reports referenced, the constructor shall immediately notify, orally and in writing; an inspector at the office of the Ministry of Labour nearest the workplace, the owner/representative, the Contractor and the joint health and safety committee or the health and safety representative, if any, for the workplace. The written notice shall include the following:

.1 The name and address of the person giving the notice;

.2 The name and address of the owner of the place where the work will be carried out;

.3 The municipal address or other description of the place where the work will be carried out sufficient to permit the inspector to locate the place, including the location with respect to the nearest public highway;

.4 A description of the work that will be carried out;

.5 The starting date of the work that will be carried out; and

.6 The name and address of the supervisor in charge of the work.

.4 No work that is likely to involve handling, dealing with or disturbing or removing the discovered materials shall be done unless it has been determined whether the material is asbestos-containing; or, the work is performed in accordance to Ontario Regulation 278/05 as though the materials were asbestos-containing materials and, in the case of sprayed-on friable material, as though it contained a type of asbestos other than Chrysotile.

2.2 ASBESTOS ABATEMENT

.1 Where required to complete the scope of the proposed renovations, disturbance of Asbestos-Containing Materials shall be performed as follows, in accordance with Ontario Regulation 278/05:

Location	ACM	Asbestos Operation	Notes
Gymnasium (Room 143), Gymnasium Storage (Room 143C), 2nd Floor Mechanical Room (Room 206A)	Insulation on Pipe Fittings	Type 2	Removal using a glove bag
Gymnasium Storage (Room 143C)	Vinyl Floor Tiles and Associated Mastic	Type 2	Unlikely that vinyl floor tile can be separated from associated mastic, so materials shall be removed and disposed of concurrently Removal using power grinder with HEPA-attachment
Staff Room Kitchen (Room 130)	Drywall Ceiling	Type 1	Removal of less than 1 square meter
		Type 2	Removal of 1 square meter or greater

2.3 SCHEDULING

.1 The Contractor shall schedule and perform work in accordance with the Contract Time established in the agreement.

2.4 INSPECTION

.1 From project set-up to completion of clean-up, the Asbestos Abatement Consultant will be present on both the inside and outside of the work area.

.2 Inspections will be conducted to confirm the Contractor's compliance. Failure to comply with the specified requirements may result in a stoppage of work at no additional cost to the Owner.

.3 Promptly notify the Consultant of any ACM or potential ACM discovered during the work and not apparent in the audit, specifications or site meeting(s). DO NOT disturb such material until given direction by the Consultant. Assume such material to contain asbestos of a type other than Chrysotile until proven otherwise. Failure to notify the Consultant of ACM prior to removal will result in the dispute of payment of fees for any extra work performed.

.4 The following inspections will be conducted at the Owner's cost. Provide Consultant with minimum of 24 Hours verbal notice:

.1 Pre Start Inspection: conducted after completion of work area set-up and prior to start of contaminated work.

.2 Contaminated Work Inspections: inspections and routine monitoring of the abatement will be conducted for the duration of the work.

.3 Final Inspection: conducted after removal of all ACM, and application of lockdown agent to confirm cleanliness. Additional labour or materials expended by the Asbestos Abatement Contractor to provide satisfactory performance to the level specified shall be at no additional cost.

2.5 SUBMITTALS

.1 Submit to the Consultant upon request:

.1 AAW and AAS certification and relevant training for all workers/supervisors on-site and involved in the project.

.2 Names, credentials and contact information of Site superintendent and shift supervisors.

.3 All necessary permits, certificates, and documents for all aspects of the work to be completed.

.4 Ministry of Labour Notice of Project if applicable.

.5 Certificate of Approval for transportation of asbestos waste.

.6 Negative air unit performance leak tests.

.7 HEPA/P100 filtered vacuum performance leak tests.

.8 Any and all proposed changes, alterations, deviations intended to be made in scope, procedures and/or measures from these specifications or associated regulations, guidelines and standards.

.2 The contractor shall have all asbestos waste transported under a current and valid Certificate of Approval or Provisional Certificate of Approval that specifically authorizes the transportation of asbestos waste in bulk. A copy of the Certificate of Approval will be maintained on-site and within the transport vehicle(s) and will be provided to the Consultant upon request.

2.6 PERMITS AND REGULATIONS

.1 Comply with all federal, provincial and local requirements, Regulations and Acts as well as client/owner corporate policies and procedures pertaining to asbestos and health and safety, provided that in any case of conflict among these requirements or with these specifications the more stringent requirements shall apply.

.2 Comply will all aspects of the Occupational Health and Safety Act Revised Statues of Ontario, 2005.

.3 Comply with Ontario Regulation 278/05 “Asbestos on Construction Projects and in Buildings and Repair Operations”, made under the Occupational Health and Safety Act.

.4 Comply with “Handling, Transportation and Disposal of Asbestos Waste’ in accordance with Ontario Regulation 347 as amended by Ontario Regulation 558/00, under the Environmental Protection Act (General-Waste Management), June 1992.

.5 Before varying a measure or procedure described in Ontario Regulation 278/05, or these specifications, the contractor/constructor must ensure that the varied measure(s) and/or procedure(s), affords protection for the health and safety of workers and building occupants that is at least equal to the protection that would be provided by complying with Ontario Regulation 278/05. Written notice of the varied measure(s) and/or procedure(s) shall be given in advance to the joint health and safety committee and safety representative, if any, for the workplace. Such notice shall also be provided to the Consultant.

2.7 INSTRUCTION AND TRAINING

.1 It shall be the responsibility of the Constructor to inform all workers involved in this project of the hazards in regard to the work to be performed and ensure appropriate training has been provided to all workers.

.2 Every worker shall be properly trained in accordance with Section 19 of Ontario Regulation 278/05 in the removal/management of asbestos as a Type 1, Type 2 and Type 3 Operation and have had instruction and training in:

.1 Asbestos awareness;

.2 The hazards of asbestos exposure;

.3 Personal hygiene and work practices;

.4 The use, cleaning, maintenance, selection and disposal of respirators and protective clothing; and

.5 The measures and procedures prescribed by Ontario Regulation 278/05.

.3 Instruction and training related to personal protective equipment and hygiene shall include but shall not necessarily be limited to:

.1 Limitations of the equipment;

.2 Inspection and maintenance of the equipment;

.3 Fitting of the equipment; and

.4 Disinfecting and decontamination of the equipment.

.4 The abatement contractor shall ensure that every worker/supervisor involved in a Type 3 operation meets the training and certification requirements of Section 20 of Ontario Regulation 278/05.

2.8 WORKER PROTECTION

.1 All personal protective equipment shall be used and maintained in accordance to the manufactures specifications and/or federal, provincial, local regulations and Acts and any corporate policies and procedures.

.2 All Personal protective equipment shall be of a nature that can be readily and effectively decontaminated or shall be of a disposable type.

.3 Damaged, deteriorated or defective personal protective equipment shall be repaired or replaced immediately and the worker shall not continue with their duties until such damages, deterioration or defects have been corrected.

.4 All personal protective equipment shall be durable enough and otherwise suitable to withstand the nature of the work being performed and the environmental conditions present within the work area(s).

.5 The contractor shall provide all workers with personally issued respirators suitable for protection against asbestos and acceptable to the Ministry of Labour.

.6 It shall be the responsibility of the contractor/constructor to ensure that all procedures for the use of respiratory equipment in accordance with Ontario Regulation 278/05 and manufacturers requirements are complied with. This shall include but shall not necessarily be limited to:

.1 The worker being physically able to perform the required duties while wearing the respirator;

.2 Respirators must be fit checked by qualitative or quantitative fit testing. Instruction must be provided as defined by the Occupational Health and safety Act;

.3 Air purifying respirators will be equipped with Ministry of Labour and NIOSH approved N 100, P 100, R 100 or HEPA hard exterior cassette style filters and shall be fitted so that an effective seal exists between the respirator and the workers face;

.4 Supplied air respirators will have supply air meet the Canadian Standards Association (CSA) standard Z180.1-00, Compressed Breathing Air and Systems (March 2000);

.5 Cleaning and disinfecting of respirator(s) after each use or more often if needed;

.6 Inspection of respirator(s) and/or respiratory equipment before each use;

.7 The proper storage in a clean, dry and sanitary location when respirator(s) are not in use; and

.8 The development of written procedures regarding selection, use and care of respirators.

.7 Protective Clothing: The contractor shall provide every worker who enters the work area with disposable coveralls and gloves which:

.1 Shall be made of a material that does not readily retain nor permit the penetration of asbestos fibres;

.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 garment and skin under the protective clothing;

.3 Shall include suitable footwear; and

.4 Shall be repaired or replaced if torn or damaged.

.8 The contractor shall provide worker(s) with Canadian Standards Association approved head, hearing and foot protection for the work being performed and as required by applicable construction safety regulations.

2.9 AUTHORIZED VISITOR PROTECTION

.1 The contractor shall provide all prescribed personal protective equipment to authorized visitors to the work area(s).

.2 Ensure authorized visitors have received required training prior to entry to the work areas.

.3 Instruct authorized visitors in all relevant procedures to be followed while in and around the work area(s).

PART 3 - APPROVED PRODUCTS

3.1 MATERIALS AND EQUIPMENT

.1 Amended Water: Water with a surfactant agent added to reduce water tension for thorough wetting of fibres.

.2 Decontamination Shower: For the purpose of worker decontamination, a portable self-contained shower equipped with the following shall be utilized:

.1 Hot and cold water connections;

.2 Interior hot and cold fixtures that can be controlled by the person using the shower; or provide a constant water temperature of not less the 40 Celsius but not greater 50 Celsius;

.3 A containment basin of sufficient capacity to collect and contain the quantity of water required for at least one worker to properly decontaminate; and

.4 Shall be supplied with soap and clean towels.

.3 Drop Sheets: Fire retardant Polyethylene: 0.15mm (6mil) minimum thickness or Fire retardant Fibre Reinforced (FR) polyethylene: 0.15mm (6mil) minimum thickness. New Materials Only.

.4 Exhausted Ducting: For use with Negative Air Unit(s) shall be flexible reinforced heavy duty type duct and be free of tears, punctures and damage and be otherwise suitable for the conditions of the work area(s). The cross sectional area of the ducting shall be maintained during the operation of the Negative Air Unit(s). And reasonable care shall be taken to ensure the ducting does not become damaged.

.5 Micronic Water Filter: Shall be used to filter contaminated water that is to be discharged to local sanitary sewers. Contaminated water includes but is not necessarily limited to wash down water and decontamination shower water. The filter shall be equipped with a

secondary 5 micrometer filter. As an alternative to filtration, contaminated water may be collected in appropriate waste containers for off-site disposal.

.6 Negative Air Units: Shall be equipped with HEPA/P100 filters and shall have performance leak testing to verify efficiency of filters. Copies of filter tests shall be provided to the consultant upon request.

.7 Power Tools: Used in the cutting, grinding, drilling, abrading, sanding, vibrating or removal of Asbestos Containing Material, as a Type 2 Operation, shall be equipped with an effective dust collection device with a HEPA/P100 filtration system capable of capturing all debris and dust generated by the tool. All tools and assemblies of dust collection and filtration equipment will be subject to approval and testing by the Consultant as seen fit prior to use.

.8 Pressure Differential Measuring Device: Shall be capable of measuring pressure differential of 0.02 inches of water column and shall otherwise measure pressure differential in an appropriate range and interval. The device shall be dedicated to the site/work area, properly calibrated, installed and maintained throughout the duration of work to measure pressure differential between the enclosed removal area and the occupied area and shall be acceptable to the consultant. Daily records shall be kept by the contractor, on site, and made available to the consultant.

.9 Sealant: A suitable water based post-removal sealer appropriate for the lock-down and sealing of asbestos fibres to polyethylene sheeting and cleaned substrate.

.10 Sprayer(s): Shall be capable of delivering low velocity mist pattern spray of Amended water or sealant. Sprayers may be hand held reservoir type or powered airless units.

.11 Surfactant: A commercial or industrial agent that when added to potable water reduces surface tension.

.12 Tape: Shall be able to create and maintain a suitable seal on polyethylene and other materials within the work area under both wet and dry conditions and ambient temperatures for the duration of the work being performed and shall otherwise be suitable for the work being performed.

.13 Waste Containers: Waste shall be contained in two overlying dust tight containers impervious to asbestos fibres. The outer container shall be a minimum of 0.15mm (6mil.) thick sealable polyethylene waste bag.

.1 Should the waste material include sharp objects/materials, the inner container shall be a sealable metal, cardboard, fibre or plastic type suitable to resist puncturing of the containers;

.2 Containers shall be cleaned with a damp cloth or vacuum equipped with a HEPA filter immediately before being removed from the work area;

.3 Outer waste containers shall have a pre-printed cautionary asbestos warning identifying it as asbestos waste in both official languages clearly visible and legible in a colour which contrasts with the background on which it is printed; and,

.4 Be otherwise suited for the waste being contained.

.14 Vacuums: Shall be equipped with HEPA/P100 filters and shall have performance leak

testing to verify efficiency of filters. Copies of filter tests shall be provided to the consultant upon request.

3.2 SIGNAGE AND PLACARDS

.1 Before beginning work, post a sufficient number of signs at each entrance/exit to the work area(s) warning of asbestos hazards and restricting access to authorized persons wearing personal protective equipment.

.2 On both sides of all containers and vehicles used in the transport of asbestos waste in large easily legible letters of a minimum of ten centimetres (10cm) in height which contrast in colour with the background of the container or vehicle the following words shall be clearly displayed:

.1 CAUTION: CONTAINED ASBESTOS FIBRES; Avoid Creating Dust and Spillage; and,

.2 Asbestos May be Harmful to Your Health; Wear Approved Protective Equipment.

PART 4 - EXECUTION

4.1 GENERAL REQUIREMENTS – ALL PROCEDURES

.1 Before beginning work, post at each entrance/exit to the work area(s) a sufficient number of signs warning of asbestos hazards and restricting access to authorized persons wearing personal protective equipment.

.2 Eating, drinking, chewing or smoking shall not be permitted in the work area.

.3 Where wet removals are to take place de-energize and disable with proper lock-out tag-out procedures electrical systems.

.4 Temporary electrical distribution systems equipped with Ground Fault Circuit Interrupters (GFCI) shall be supplied and used by the Contractor during wet removals.

.5 Remove all items from the work area(s). If items are affixed or otherwise cannot be removed from the work area(s), ensure that they are pre-cleaned using a HEPA/P100 filtered vacuum or damp wiping and completely covered and sealed with polyethylene sheeting and otherwise adequately protected.

.6 Before commencing with work, disable and seal all ventilation to and from the work area and ensure ventilation remains disabled throughout the duration of activities. Seal any and all openings within the work area(s).

.7 Removal of Asbestos Containing Materials shall commence only after set-up is complete.

.8 Frequently and at regular intervals during the Work and immediately upon completion of the work clean up and place all asbestos dust, debris and waste in approved waste containers.

.9 Prevent the spread of dust from the Work Area.

.10 At completion of Work or at the end of the work day, remove from work area(s) all asbestos waste and in accordance with requirements of Ontario Regulations and these specifications dispose of asbestos waste off-site.

4.2 EXECUTION OF TYPE 1 OPERATION

.1 Set-Up

.1 Ensure adequate signage is posted restricting access to the work area to authorized personnel.

.2 Prevent the spread of dust from the work area using measures appropriate to the work to be done. Use single layer rip proof polyethylene drop sheets. In areas with carpeted or textured floors which cannot be readily cleaned use double layer rip proof polyethylene over flooring in work area(s).

.3 Provide facilities for washing hands and face.

.4 Allow for inspection by the Consultant to confirm that set-up is sufficient prior to the start of work.

.2 Asbestos Removal

.1 If a worker requests, the contractor shall supply a respirator in accordance with Ontario Regulation 278/05 Table 2 requirements, suitable for protection against asbestos and protective coveralls and the worker shall wear the respirator and coveralls.

.2 Perform removal of ACM in a manner to reduce dust creation to lowest level practicable by:

- Dust and waste shall not be permitted to fall freely from one work level to another
- Use of hand tools only for the removal of ACM
- Careful removal of ACM
- Continual wetting of Asbestos Containing Materials throughout the work
- Placing removed asbestos waste directly into approved waste containers

.3 All workers shall proceed to washing facilities and wash hands and face before leaving the work area.

.3 Clean-Up

.1 After completion of the removal; perform final thorough cleanup of polyethylene, barriers, drop sheets, tools, equipment, items, work area(s) and adjacent areas using HEPA/P100 filtered vacuum or damp wiping methods. Ensuring work area(s) and all items within the work area(s) are clean of visible asbestos dust, debris and waste. Place and seal asbestos dust debris and waste in approved waste containers.

.2 Allow for inspection by Consultant to determine abatement is complete and an acceptable level of cleanliness prior to application of sealant.

.3 Wet and fold polyethylene drop sheets and barriers in a manner which contains

asbestos dust, debris and waste, place and seal in approved waste containers.

.4 If Personal Protective Equipment was requested and used by the worker prior to leaving the work area(s) clean all asbestos dust, debris and waste from clothing and personal protective equipment (PPE). Remove and place disposable PPE in approved waste container.

.5 Immediately before their removal from the work area, clean each filled waste container using HEPA/P100 filtered vacuum and place and seal in a secondary clean waste container.

4.3 EXECUTION OF TYPE 2 OPERATION

.1 Set-Up

.1 Construct an enclosure using polyethylene sheeting that extends from floor to ceiling and encompasses the entire work area were asbestos containing materials will be removed or encapsulated. The enclosure shall include the following:

- Double flap weighted air lock doors at all entrances, exits and doorways of the enclosure and rooms within the enclosure;
- Transparent windows for inspection purposes from outside the enclosure area;
- Sealed edges of the entire enclosure using tape or other suitable methods; and
- Ensure all edges of enclosure are securely fixed.

.2 Construct a decontamination facility as close as practicable to the work area which shall include the following:

- A room suitable for changing into protective clothing and for storing contaminated protective clothing and equipment; and,
- A room suitable for changing into street clothes and for storing clean clothing and equipment.

.3 Arrange configuration of the above-mentioned rooms so that (a) person(s) entering/exiting the work area must pass through each room in the correct order.

.4 Allow for inspection by the Consultant to confirm that set-up is sufficient prior to the start of work.

.2 Asbestos Removal

.1 Workers entering the work area shall don all appropriate personal protective equipment including coveralls and respiratory protection prior to entering the work area.

.2 Before commencing with work and at the beginning and end of each work shift and at a minimum of at least once per day the enclosure shall be inspected for any defects of deficiencies.

.3 Any defects or deficiencies observed shall be repaired forthwith and no work other than such repairs shall be conducted until repair activities are completed

.4 Other than loose material which is pulverized, crumbled and or powdered and shall be removed by HEPA/P100 filtered vacuum, Asbestos Containing Materials to be removed or disturbed shall be thoroughly wetted with Amended Water before and during work unless wetting creates a hazard or causes damage.

.5 Perform removal of ACM in a manner to reduce dust creation to lowest level practicable by:

- Dust and waste shall not be permitted to fall freely from one work level to another;
- Use of hand tools only for the removal of ACM;
- Careful removal of ACM;
- Continual wetting of Asbestos Containing Materials throughout the work; and
- Placing removed asbestos waste directly into approved waste containers.

.6 All workers shall proceed to the washing facilities while wearing respirator and shall wash hands and face before leaving the work area.

.3 Clean-Up

.1 After completion of the removal; perform final thorough cleanup of polyethylene, barriers, tools, equipment, items, work area(s) and adjacent areas using HEPA/P100 filtered vacuum or damp wiping methods. Ensuring work area(s) and all items within the work area(s) are clean of visible asbestos dust, debris and waste. Place and seal all asbestos dust debris and waste in approved waste containers.

.2 Allow for inspection by Consultant to determine abatement is complete and an acceptable level of cleanliness prior to application of sealant.

.3 Apply sealant to all vertical and horizontal surfaces, enclosures, drop sheets and items within the enclosure. Allow sufficient time for sealant to dry.

.4 Wet and fold polyethylene and barriers in a manner which contains asbestos dust, debris and waste, place and seal in approved waste containers.

.5 Prior to leaving the work area(s) workers shall clean all asbestos dust, debris and waste from Personal Protective Clothing Using HEPA/P100 filtered vacuum or damp wipe methods prior to removing the clothing. Remove and place disposable Personal Protective Clothing in approved waste containers.

.6 Immediately before their removal from the work area, clean each filled waste container using HEPA/P100 filtered vacuum and place and seal in a secondary clean waste container.

4.4 EXECUTION OF TYPE 2 OPERATION (GLOVE BAG)

.1 Set-Up

.1 The work area shall be separated from the rest of the workplace by walls, barricades, fencing or other suitable means.

.2 Surfaces directly below the work area shall be covered with drop sheets of

Polyethylene.

.3 The glove bag shall be made of material that is impervious to asbestos and sufficiently strong to support the weight of material the bag will hold.

.4 The glove bag shall be equipped with,

- Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period;
- Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure;
- A tool pouch with a drain;
- A seamless bottom and a means of sealing off the lower portion of the bag; and,
- A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

.5 Provide facilities for washing hands and face.

.6 Allow for inspection by the Consultant to confirm that set-up is sufficient prior to the start of work.

.2 Asbestos Removal

.1 Workers entering the work area shall don all appropriate personal protective equipment including coveralls and respiratory protection prior to entering the work area.

.2 A glove bag shall not be used to remove insulation from a pipe, duct or similar structure if:

- It may not be possible to maintain a proper seal for any reason including, without limitation: the condition of the insulation; or, the temperature of the pipe, duct of similar structure; and,
- The bag could become damaged for any reason including, without limitation: the type of jacketing; or, the temperature of the pipe, duct or similar structure.

.3 The glove bag shall be inspected for damage or defects:

- Immediately before it is attached to the pipe, duct or other similar structure; and,
- At regular intervals during its use.

.4 If damage or defects are observed at any time during the use of the glove bag:

- The use of the glove bag shall be discontinued;
- The inner surface of the glove bag and the contents, if any, shall be thoroughly wetted with Amended Water;
- The glove bag and the contents, if any, shall be removed and placed in a waste container, and,

- The work area shall be cleaned using a HEPA/P100 filtered vacuum before removal work is resumed.

.5 All workers shall proceed to the washing facilities while wearing respirator and shall wash hands and face before leaving the work area.

.3 Clean-Up

.1 When the removal work is complete:

- The inner surface of the glove bag and the waste inside shall be thoroughly wetted with Amended Water and the air inside the bag shall be removed through the elasticized valve, by means of HEPA/P100 filtered vacuum;
- The pipe, duct or similar structure shall be wiped down and a sealant applied;
- The glove bag, with the waste inside, shall be placed in a waste container, and,
- The work area shall be cleaned using a HEPA/P100 filtered vacuum or by damp wiping.

.2 Prior to leaving the work area(s) workers shall clean all asbestos dust, debris and waste from Personal Protective Clothing Using HEPA/P100 filtered vacuum or damp wipe methods prior to removing the clothing. Remove and place disposable Personal Protective Clothing in approved waste containers.

.3 Immediately before their removal from the work area, clean each filled waste container using HEPA/P100 filtered vacuum and place and seal in a secondary clean waste container.

END

1. Definitions

1. The following Section of this Specification are of the abbreviated type and include incomplete sentences. Definite and indefinite articles have often been omitted and sentences are written in the form of direct instructions to the Contractor without using the phrase `the Contractor shall.' Standard specifications and other quality references inserted govern materials and workmanship without using phrases `conform with,' `conformity therewith,' etc. Omitted words and phrases to be supplied in the same manner as they are when a note appears on the Drawings.

2. The Specifications are separated into Sections for reference convenience only. Such separation must in no instance make Owner or his Consultants arbiter to establish subcontract limits between Contractor and Subcontractor.

3. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on Drawings and/or in Specifications, including all labour, materials, equipment, tools, services, and incidentals necessary and required to complete the work. Responsibility for breakdown into and extension of subcontracts, including co-ordination of same, rests entirely with the Contractor.

4. Standard Specifications referred to are editions in force at Tender Closing Date.

2. Terminology

1. Consultants are the team of Architects, Engineers and other experts commissioned by the Owner, directly or indirectly, to execute design, contract documents and supervision for the project, including any of their agents or employees.

2. Prime Consultant is the Architect.

3. Contractor is the Firm or Corporation who, having signed the Agreement, has the sole legal responsibility to carry out the work shown or described in the Contract Documents for the Owner, whether contractually assigned to a Subcontractor or supplier, or not.

3. Minimum Standards

1. Unless otherwise specified, work and material to conform or exceed the minimum standards set out in the editions of the Canadian Government Specification Board, Canadian Standards Associations, the Ontario Building Code, Underwriters' Laboratories of Canada, the Canadian Electrical Code, the Local Building Code in force, whichever is applicable.

2. Copies of Standard Specifications referred to in this Specification to be kept on the site.

3. The use of the name (or its abbreviation) of any of the following bodies, accompanied by the reference number of a specification of that body to mean that the entire specification of the body to apply as noted:

AISC: American Institute of Steel Construction;
ASTM: American Society for Testing Materials;
CEC: Canadian Electric Code;
CGSB: Canadian Government Specification Board;
CISC: Canadian Institute of Steel Construction;
CRCA: Canadian Roofing Contractors' Association;
CSA: Canadian Standards Association;
OBC: Ontario Building Code;
ULC: Underwriters' Laboratories of Canada;
CLA: Canadian Lumbermen's Association.

4. Cooperation

1. Each trade to co-operate with the trades of adjacent or affected work. Supply in good time requirements affecting adjacent and underlying work in writing and items to be set or built in. Similarly, heed requirements and build-in items provided by other trades.

2. Take necessary precautions to protect work of other trades from contamination, marring or other damage due to application or installation processes, methods and activities.

3. General Contractor and each trade to co-operate with Contractors which may be assigned or selected by the Owner to perform work under Cash Allowances. Owner reserves the right to assign non-unionized labour to perform work under Cash Allowances, at Owners discretion.

5. Coordination

1. Co-ordinate the work of all trades in such a manner that each trade co-operates with the trade of adjacent work.

2. Organize weekly job site meetings and send out notices stating time and place to Consultants, subcontractors, Suppliers and all others whose presence is required at the meetings.

3. Take note of all persons attending these meetings and submit to Consultants and Owner, Minutes of these Meetings showing any major decisions made and instructions or information required.

4. Co-ordinate the Work in this Contract with the work of others awarded work under Cash Allowances.

6. Building Dimensions and Co-ordination

1. Ensure that all necessary job dimensions are taken and all trades are coordinated for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for co-ordination.

2. Verify that all work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by

requirements of the drawings, and ensure that work installed in error is rectified before construction resumes.

3. Check and verify all dimensions referring to the work and the interfacing of all services. Verify all dimensions with the trade concerned when pertaining to the work of other trades. Be responsible to see that Subcontractors for various trades co-operate for the proper performance of the Work.

4. Avoid scaling directly from the drawings. If there is ambiguity or lack of information, immediately inform the Consultant. Be responsible for any change through the disregarding of this clause.

5. All details and measurements of any work which is to fit or to conform with work installed shall be taken at the building.

6. Advise Consultant of discrepancies and if there are omissions on drawings, particularly reflected ceiling plans and jointing patterns for paving, ceramic tile, or carpet tile layouts, which affect aesthetics, or which interfere with services, equipment or surfaces. DO NOT PROCEED without direction from the Consultant.

7. Ensure that each Subcontractor communicates requirements for site conditions and surfaces necessary for the execution of the Subcontractor's work, and that he provides setting drawings, templates and all other information necessary for the location and installation of material, holes, sleeves, insets, anchors, accessories, fastenings, connections and access panels. Inform other Subcontractors whose work is affected by these requirements and preparatory work.

8. Prepare interference drawings to properly co-ordinate the work where necessitated. Refer to Section 01340.

7. Use of Premises Before Substantial Performance

1. The Owner shall have the right to enter and occupy the building, in whole or in part, for the purpose of placing fittings and equipment, or for other use, before completion of the Contract if, in the opinion of the Consultant, such entry and occupancy does not prevent or interfere with the Contractor in the performance of the Contract. Such entry shall in no way be considered as an acceptance of the Work in whole, or in part, nor shall it imply acknowledgment that terms of the Agreement are fulfilled.

8. Layout of Work

1. Layout work with respect to the work of all trades. Arrange mechanical and electrical work such as piping, ducts, conduits, panels, equipment and the like to suit the architectural and structural details.

2. Alterations necessary due to conflict and interference between trades, to be executed at no cost to the Owner unless notification is given in writing before Tender Closing Date.

9. By-Laws and Regulations

1. Nothing contained in the Drawings and Specifications are to be so construed as to be knowingly in conflict with any law, by-law or regulation of municipal, provincial or other authorities having jurisdiction.

2. Perform work in conformity with such laws, by-laws and regulations and make any necessary changes or deviations from the Drawings and Specifications subsequently required as directed and at no cost to the Owner unless notification is given in writing before Tender Closing Date.

3. Furnish inspection certificates and/or permits as may be applicable as evidence, that installed work conforms with laws, by-laws, and regulations of authorities having jurisdiction.

10. Protection

1. Take necessary precautions and provide and install required coverings to protect material, work and finishes from contamination, damage, the elements, water and frost.

2. Make good any damage or replace damaged materials, as directed. Repairs to be made by the trade having originally installed or fabricated the damaged material, finish or item. Protect electrical equipment from water and the elements.

3. Protect adjacent private and public property from damage and contamination.

4. Protect curbs and sidewalks from damage from trucking by means of boards and the like. Repair, or pay or repair of damage to existing roads and sidewalks.

5. Mark glass after glazing in an acceptable manner and leave in place until final clean-up.

6. Protect floor finishes from construction traffic and transport of construction materials and equipment by means of 6 mm plywood panels.

11. Delivery, Handling and Storage of Materials

1. Schedule material delivery so as to keep storage at site to the absolute minimum, but without causing delays due to late delivery.

2. All deliveries to the school premises must be scheduled to arrive when no students are outside. This includes avoiding times when students are arriving, departing, or during outdoor activities.

3. Any maneuvering of vehicles or equipment within or around the school premises must be conducted while students are in class. This excludes maneuvering during breaks, lunch periods, or any other times when students might be outside.

4. All site maneuvering activities must be accompanied by a flag person to ensure the safety of students and staff.

5. Store materials which will be damaged by weather in suitable dry accommodation. Provide heat, as required, to maintain temperatures recommended by material manufacturer.

6. Store highly combustible or volatile materials separately from other materials, and under no circumstances, within the building. Protect against open flame and other fire hazards. Limit volume of supply on the site to minimum required for one day's operations.

7. Handle and store material so as to prevent damage to material, structure and finishes. Avoid undue loading stresses in materials or overloading of floors.

8. Do not store material and equipment detrimental to finished surfaces within areas of the building where finishing has commenced or has been completed. No storage will be available within the school. Contractor to make necessary arrangements exterior to the school in storage containers as needed. Coordinate locations with school prior to placement and protect all existing surfaces.

9. Deliver package material in original, and Storage of unopened and undamaged containers with manufacturer’s labels and seals intact.

12. Debris

1. Assign clean-up duties to a crew with own Foremen which will be of sufficient size to prevent accumulation of debris and dirt in any part of the structure or on the site.

2. Remove construction debris on a daily basis and legally dispose of same.

3. Under no circumstances should debris, rubbish or trash be burned or buried on the site.

13. Cutting, Fitting and Patching

1. Required cutting to be done by General Contractor. Patching and painting of work to be executed by the General Contractor.

2. All sub-trades are to notify the General Contractors bidding as to the extent of the cutting, patching, and painting of their respective trades.

3. Drilling, cutting, fitting and patching necessary due to failure to deliver items to be built-in time, or installation in wrong location to be executed, as directed, at no cost to the Owner.

4. Give written notification prior to commencement of drilling and cutting of load bearing structural members and finished surfaces.

5. Cut holes with smooth, true, clean edges, after they are approved by applicable trade. Size holes and openings for hot water and steam pipes, so as to allow for expansion and contraction of such pipes.

14. Fastenings

1. Supply all fastenings, anchors and accessories required for fabrication and erection or work.

2. Metal fastenings to be of the same material as the metal component they are anchoring, or of a metal which will not set up an electrolysis action which would cause damage to the fastening or metal component under moist conditions.

3. Exposed metal fastenings and accessories to be of the same texture, color, and finish as base metal on which they occur. Keep to a minimum; evenly space and lay out.

4. Fastenings to be permanent, of such a type and size and installed in such a manner to provide positive anchorage of the unit to be secured. Wood plugs are not acceptable. Install anchors at required spacing to provide required load bearing or shear capacity.

5. Power actuated fastenings are not to be used without prior written approval for specific use.

15. Surplus Materials

1. Surplus materials specifically so specified, to remain property of the Owner and be neatly stockpiled or stored, as directed.

2. All other surplus materials to become property of the Contractor; to be removed from the site and legally disposed of.

16. Documents Required and General Duties

1. **At Commencement of Contract**
   - .1 The Owner has paid for the cost of the Building Permit. Mechanical Subcontractor will pay the cost of other Fees related to the Work Specified under Mechanical Scope. Electrical Subcontractor will pay the cost of all permits and fees related to the Work specified under Electrical Scope.
   - .2 The General Contractor is to pay all other fees and refundable deposits if applicable.

2. **During Construction**
   - .1 Adjust Allowances, as required.
   - .2 Organize Job Meetings in accordance with Section 01200.
   - .3 Supply Monthly Progress Reports and Construction Schedule in accordance with Section 01200.
   - .4 Confirm that payments are being made to subcontractors and suppliers by submission of receipts with the second and subsequent Progress Payment Application. No payment will be made for unincorporated material on the site, unless Bill of Sale in proper format is provided.

3. **Upon Completion**

   1.Upon completion of work before the Final Certificate of Payment is issued, the

following to be observed, executed and submitted:

.1 All deficiencies to have been completed in a satisfactory manner.
.2 All final clean-up to have been executed, as specified in Section 01710.
.3 Finishing Hardware, Inspection and Verification.
.4 Organize a Final Inspection tour at which to be present:
- the Owner's authorized representative;
- the Architectural, Structural, Mechanical and Electrical Consultants, and their supervisory personnel, if any;
- the Contractor and his superintendent.

.5 Where the above procedure is impossible or where any deficiencies remain outstanding, the Owner's representative and the Consultant concerned, to inspect and accept the affected work and/or material upon notification by the Contractor, that all deficiencies involving this Consultant have been made good.
.6 A complete release of all liens arising out of this Contract, other than his own. If a subcontractor or supplier refuses to furnish a release of such a lien, furnish a bond satisfactory to the Owner to indemnify him against any claim under such a lien.
.7 Certificates of good standing from the Workers' Compensation board, for the General Contractor and all Subcontractors.
.8 All reference records, as specified, under Section 01720.
.9 Certificate of Inspection from Mechanical and Electrical Engineers.
.10 Copies of all Lists of Deficiencies with each Deficiency verified when complete by only this project's job Superintendent. The Final List of Deficiencies to be signed, completed by all concerned, if accepted.
.11 Statement of Completion from General Contractor.
.12 Final adjustment of all Allowances.
.13 H.E.P.C. Inspection Certificate and all other Inspection Certificates required by Provincial, Municipal and other authorities having jurisdiction.
.14 Balancing Reports.
.15 As-Built Drawings. – Hardcopy mark ups and digital pdf files and AutoCAD v2018 or higher.
.16 One hard copy of Operation and Maintenance Manuals. A digital copy (pdf file) of all closeout documents to be provided on USB memory stick format.

17. Progress Reports

1. Submit to the Architect, Monthly Progress Reports consisting of a concise narrative and a marked-up summary schedule showing physical percentage complete by item and in total. These progress calculations must agree with the Progress Payment Claims.

2. Keep permanent written daily records on the site on the progress of work. Record to be open to inspection at reasonable times and copies to be furnished upon request. Records to show notes of commencement and completion of different trades and parts of work; daily high and low temperatures and other weather particulars; number of men engaged on the site (including sub-trades) broken down in groups for each type of construction work, and particulars about excavation and shoring; erection and removal of form work; pouring and curing of concrete; floor finishing; placing and compaction of backfill, masonry work; roofing.

3. Daily progress to give particulars on commencement and completion of each trade or part of work; form work erections and removal; concrete pouring and curing; floor finishing; masonry work; roofing; waterproofing; finishing trades, tests and inspection and the like.

18. Inspection and Testing

1. The contractor is responsible to provide his own quality control in order to meet or exceed the requirements of specified standards, codes, design criteria and referenced documents.

End of Section

1. Selection of Products

1. If requested by the Consultant, provide the following services and/or information:

   .1 Assist the Consultant in determining qualified suppliers.
   .2 Obtain proposals from suppliers.
   .3 Make appropriate recommendations for consideration of Consultant.
   .4 Notify Consultant of any effect anticipated by selection of product or supplier under consideration, on construction schedule and contract sum.

2. On notification of selection, enter into purchase agreement with designated supplier.

2. Cash Allowance

1. Expend cash allowance **only** as authorized by the Owner though the Consultant's written instructions.

2. Include in Contract price the Contractor's charges for handling at site, including uncrating and storage, protection from elements and damage, labour, installation and finishing, testing, adjusting and balancing, and other expenses including overhead and profit on account of Cash Allowance in accordance with Article GC4.1 of the General Conditions of the Contract as amended.

3. Credit the Owner with any unused portion of Cash Allowances in the statement for final payment.

4. If a test made under payment by a specific allowance proves that the material or system is not in accordance with the Documents, then the subsequent testing including Owner's testing of replacement materials or systems shall be Contractor's expense and not taken from Cash Allowance.

5. Add or deduct any variation in cost from the Cash Allowance. No adjustment will be made to Contractor's expense.

6. The amount of each allowance includes the net cost of the product or service, delivery and unloading at the site.

7. All refunds, trade and/or quantity discounts which the Contractor may receive in the purchase of goods under allowances, to be extended to the Owner.

8. Receipted invoices covering all disbursements made by the Contractor under Allowances, to be submitted to the Consultant for audit.

9. Where the Cash Allowance stipulates "Supply Only," the Contract Price and not the Cash Allowances include the installation and hook-up costs. The installation and hook-up of some equipment and materials are specified under other Sections of the Specifications. The General Contract includes the installation and hook-up not specified elsewhere.

10. Contractor's profit and overhead on all Cash Allowances to be carried in his lump sum amount, not in the Cash Allowances.

11. All Cash Allowances will be dealt with in accordance with Article GC4.1 of the General Conditions.

12. All expenditures under Cash Allowances must be approved by the Owner.

13. Cash Allowance in the amount of **Twenty-eight thousand Dollars ($28,000)** for a Digital Clock, End Wall Logos, Utility Gas Application & Upgrade Fee, and Volleyball/Badminton Posts and Nets.

14. H.S.T. Goods and Services tax is not included in Cash Allowance amount and is to be carried in the General Contractor's Stipulated Sum Amount.

15. Refer to Section 01005 for co-operation with others assigned to this Section.

End of Section

1. Project Meetings for Coordination

1. Following the pre-construction meeting/construction phase kick-off meeting, arrange for site meetings every 2 weeks as appropriate to the stage of construction, for project coordination. Such meetings shall fall at the same time each week the meeting is scheduled. Prior to substantial performance, meetings shall be scheduled for every week in an effort to effectively complete all obligations under the contract in a timely manner.

2. General contractor's site supervisor and project manager as well as other responsible representatives of the Contractor's and Subcontractor's office and field forces and suppliers shall be obliged to attend.

3. Inform the Owner, Consultant, and those others whose attendance is obligatory, of the date of each meeting, in sufficient time to ensure their attendance.

4. Provide physical space for meetings within the construction office, prepare an agenda, chair and record the minutes of each meeting. Relevant information must be made available to all concerned, in order that problems to be discussed may be expeditiously resolved. Identify "action by: _____".

5. Within three days after each meeting, distribute digital copies of the minutes to each invited person, regardless of attendance.

2. Pre-construction Meeting

1. Within 5 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

3. Project Meetings for Progress of Work

1. Conduct progress meetings in accordance with the schedule and/or decisions made at Pre-construction meeting.

2. Inform the Owner, Consultant, project consultants, Subcontractors and suppliers and those whose attendance is obligatory, of the date of the meeting, in sufficient time to ensure their attendance.

3. Include in the agenda the following:

    .1 Review, approval of minutes of previous meeting.
    .2 Review of Work progress since previous meeting.
    .3 Field observations, problems, conflicts.
    .4 Problems which impede construction schedule.
    .5 Review of off-site fabrication delivery schedules.
    .6 Corrective measures and procedures to regain projected schedule.
    .7 Revisions to construction schedule.
    .8 Progress during the preceding work period.
    .9 Look ahead for the succeeding two-week work period.

.10 Review submittal schedules: expedite as required.
.11 Maintenance of quality standards.
.12 Pending changes and substitutions.
.13 Review proposed changes for effect on construction schedule and on completion date.
.14 Other business

4. Progress Records

1. Maintain a permanent written record on the site of the progress of the work using standard OGCA form. This record shall be available to the Consultant at the site, and a copy shall be furnished to same on request. The record shall contain:

    .1 Daily weather conditions, including maximum and minimum temperatures.
    .2 Dates of the commencement and completion of stage or portion of the work of each trade in each area of the project.
    .3 Conditions encountered during excavation.
    .4 Dates of erection and removal of formwork, in each area of the project.
    .5 Dates of pouring the concrete in each area of the project, with quantity and particulars of the concrete.
    .6 Work force on project daily per trade.
    .7 Visits to site by personnel of Consultant, Jurisdictional Authorities and testing companies.

End of Section

1. General

1. Submit to Architect, for review, shop drawings, product data and samples specified.

2. Until the submission is reviewed, work involving relevant products must not proceed.

2. Shop Drawings

1. Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate the appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate Sections.

2. Identify details by reference to sheet and detail numbers shown on Contract Drawings.

3. Maximum sheet size 24” x 36” as a PDF.

4. General Contractor shall provide and maintain an up-to-date shop drawing tracking log, which shall be reviewed at each construction meeting.

3. Project Data

1. Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings.

2. Above will only be accepted if they conform to following:
   .1 Delete information which is not applicable to project.
   .2 Supplement standard information to provide additional information applicable to project.
   .3 Show dimensions and clearances required.
   .4 Show performance characteristics and capacities.
   .5 Show wiring diagrams (when requested) and controls.

4. Coordination of Submissions

1. Review shop drawings, product data and samples prior to submission.

2. Verify:
   .1 Field measurements.
   .2 Field construction criteria.
   .3 Catalogue numbers and similar data.

3. Coordinate each submission with requirement of work and Contract documents. Individual shop drawings will not be reviewed until all related drawings are available.

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

5. Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Architect's review of submission, unless Architect gives written acceptance of specified deviations.

6. Notify Architect, in writing at time of submission, of deviations from requirements of Contract documents.

7. After Architect's review, distribute copies.

5. Submission Requirements

1. Schedule submissions at least fourteen (14) days before dates that reviewed submissions will be required to be returned.

2. Submit a digital copy (PDF) of shop drawings, product data to Architect for review.

3. Accompany submissions with transmittal letter, in duplicate, containing:
   .1 Date.
   .2 Project title and number.
   .3 Contractor's name and address.
   .4 Number of each shop drawing, product data and sample submitted.
   .5 Other pertinent data.

4. Submissions must include:
   .1 Date and revision dates.
   .2 Project title and number.
   .3 Name of:
      .1 Contractor.
      .2 Subcontractor.
      .3 Supplier.
      .4 Manufacturer.
      .5 Separate detailer when pertinent.

5. Identification of product or material.
   .1 Relation to adjacent structure or materials.
   .2 Field dimensions, clearly identified as such.
   .3 Specification Section number.
   .4 Applicable standards, such as CSA or CGSB numbers.
   .5 Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with Contract documents.

6. Interference Drawings
   .1 Prepare interference drawings for all work in confined space ie: ceiling space.

End of Section

1. Access

1. Provide and maintain adequate service roads to project site to provide safe and convenient access for deliveries.

2. Contractor's Site Office

1. Contractor's trailer will be used as site office during construction and to accommodate site meetings. It shall be furnished with a drawing layout table and remain for the duration of the project. Coordinate location with Owner and obtain approval.

2. Maintain in clean condition.

3. Provide and maintain in clean condition: two separate plans layout tables, minimum 48" x 72" each. One table shall be used by the General Contractor, and Subcontractors, at their discretion. The second shall be provided for use by subcontractors and by the consultant or Inspection and Testing Companies during site visits or project meetings.

4. The contractors and/or subcontractors are not permitted to use school spaces/areas form a site office/s at any time.

3. Storage Sheds

1. Provide adequate weather-tight sheds with raised floors, for storage of materials, tools and equipment. Coordinate location with Owner and obtain approval.

2. The contractors and/or subcontractors are not permitted to use school spaces/areas for storage at any time.

4. Sanitary Facilities

1. Provide portable toilets and other washroom facilities as required. Coordinate location with Owner and obtain approval. Keep area and premises in sanitary condition.

2. The contractors and/or subcontractors are not permitted to use school sanitary facilities at any time.

5. Parking

1. The contractors and/or subcontractors are responsible for coordinating parking with the local municipality.

2. The contractors and/or subcontractor are not permitted to use the school parking lots during the months of September to June. The school parking lots can be used for construction during the months of July and August. Coordinate use of spaces with Owner and obtain approval.

6. Site Enclosures

1. Erect temporary site enclosures, hoarding, using prefabricated lock fence system. Fencing shall be mechanically fastened to the ground using secure spikes on the construction side of the fence. Alternatively, construction fencing shall be mechanically fastened to the vertical t-bar piled into the ground. The ground shall be repaired to its original condition matching adjacent surfaces once the fence is no longer required and removed off site. Exterior fencing shall include visual barrier using geotextile fastened to the fence. Access into this fenced area shall be controlled by the general contractor. Maintain fence at all times for the duration of the project.

2. Interior hoarding walls shall be erected at all locations where existing occupied spaces are in the vicinity and adjacent to the construction area. All interior hoarding walls shall be constructed using stud framing and drywall. Alternatively, good-one-side plywood can be used. All hoarding walls shall include a properly latching and lockable man door complete with locking handset/lever or orbit hardware. Access through this door shall be controlled by the general contractor. Maintain hoarding walls at all times for the duration of the project.

3. Size and location of enclosure to suit area of construction.

7. Enclosure of Structure

1. Provide temporary weather-tight enclosures protection for exterior openings until permanently enclosed.
2. Erect enclosures to allow access for installation of materials and working inside enclosures.

3. Design enclosures to withstand wind pressure.

4. Erect dust barriers to prevent dust migration to non-renovated areas. Provide boot dust mats at each interior connection to occupied areas from the construction entrances/exits. If contractor is not able to prevent dust migration to non-renovated areas, the contractor shall provide negative air units and maintain for the duration of the project until such time where dust migration can be prevented.

8. Power supply

1. Electrical power is available in existing building and will be provided at no charge for construction purpose.

9. Water Supply

1. Water is available in existing building and will be provided at no charge for construction purpose.

10. Scaffolding

1. Construct and maintain scaffolding in rigid, secure and safe manner.

2. Erect scaffolding independent of walls. Remove promptly when no longer required.

3. Scaffolding to be designed by a professional Engineer when required under the Occupational Health and Safety act.

11. Heat and Ventilating

1. Not applicable.

End of Section

1. Construction Safety Measures

1. Observe and enforce construction safety measures required by the National Building Code; the O.B.C.; The Provincial Government; Workers' Compensation Board; and Municipal authorities.

2. In particular, the Occupational Health and Safety Act (Ont. Re. 213/91), the Occupational Health and Safety Act, the regulations of the Ontario Ministry of Labour and Ontario Hydro Safety requirements shall be strictly enforced.

3. Contractor shall ensure that copies of all applicable construction safety regulations, codes and standards are available on the job-site throughout the period of construction. All workers are to be informed that these documents are available for reference at any time.

4. The Contractor shall ensure that all supervisory personnel on the job-site are fully aware of the contents of the Occupational Health and safety Act (Ontario Regulation 213/91 - Construction Projects) the Workers' Compensation Act" and, Bill 208 (Chapter 7, Standards of Ontario) “An Act to Amend the Occupational Health & Safety Act and the Workers’ Compensation Act”, and, that they comply with all requirements and procedures prescribed therein. These documents include, but are not limited to, the following construction safety requirements:

    .1 Contractor to register with the Director of the Occupational Health and Safety Division before or within 30 days of the commencement of the project, (O.Reg. 213/91, sec 5).
    .2 File a notice of project with a Director before beginning work on the project, (O.Reg 313/91, sec 6).
    .3 Notification prior to trenching deeper than 1.2m, (O.Reg. 213/91, sec 7).
    .4 Accident Notices and Reports, (O.Reg. 213/91, sec 8 through sec 12).
    .5 General Safety Requirements, (O.Reg. 213/91, sec 13 through sec 19).
    .6 General Construction Requirements, e.g. protective clothing, hygiene practices, housekeeping, temporary heat, fire safety, access to the job-site, machine and equipment guarding and coverings, scaffolds and platforms, electrical hazards, roofing, et al, (O.Reg. 213/91, sec 20 through sec 221).
    .7 Establish a Joint Health and Safety Committee where more than 19 workers are employed for more than 3 months, (Bill 208, S.8(2) to S.8(14).
    .8 Establish a Worker Trades Committee for all projects employing more than 49 workers for more than 3 months, (Bill 208, S-8a(1) to S.8b(4).
    .9 Ensure that all activities arising out of (.07) and (.08) above are recorded and that minutes are available to an inspector of the Ontario Ministry of Labour.

5. The Contractor shall be considered as the "Constructor" in consideration of the rights and responsibilities for all construction safety requirements, procedures, facilities and inspection of all work performed by the Contractor, Subcontractors/Sub-trades and other Contractors engaged on this project.

6. In the event of a conflict between any of the provisions of the above authorities the most stringent provisions are to be applied.

2. Material Safety Data Sheet

1. Material safety Data Sheets (MSDS) must be available at the job-site for any product listed on the Hazardous Ingredients List prior to being used, installed or applied inside of the building.

2. A Material Safety Data Sheet is to be submitted to the Architect for any product which is known to create, or suspected of creating, a health hazard or discomfort during construction or upon commissioning of the project including, but not limited to, the following:
   .1 adhesives
   .2 solvents
   .3 sealants, (caulking, vapour seals, etc.)
   .4 sprayed-on fireproofing
   .5 resilient flooring
   .6 carpet, paint, varnish or other coatings
   .7 exposed membrane waterproofing
   .8 special coatings, (terrazo sealants, chafing coatings, etc.)
   .9 solder, brazing and welding and other filler metal
   .10 other products whose particles or vapours may become air borne after installation.
   .11 any other product as directed by the Consultant.

3. Comply with WHMIS regulation, Workplace Hazardous Material Information System.

3. Fire Safety Requirements

1. Comply with requirements for Building Construction, the Ontario Building Code, the Ontario Fire Code, the requirements of Local Fire Authorities and of the requirements of the Office of the Fire Marshal.

4. Overloading

1. Ensure no part of Work is subjected to a load which will endanger its safety or will cause permanent deformation.

5. Falsework

1. Design and construct falsework in accordance with CSA S269.1-1975.

6. Scaffolding

1. Design and construct scaffolding in accordance with CSA S269.2-M1980.

2. Scaffolding to be designed by a Professional Engineer when required under the Occupational Health and Safety Act.

7. Materials Specifically Excluded

1. Asbestos and/or asbestos-containing products are not permitted. Submit Material Safety Data Sheets for any product suspected of containing asbestos if so requested by Consultant. Examples of some materials requiring close scrutiny and/or confirmation include:
   .1 Transite drainage pipe - whether buried or above grade - not permitted.
   .2 Composite floor tile containing asbestos - not permitted.
   .3 Lay-in ceiling tiles containing asbestos - not permitted.
   .4 Insulation and/or jacketing for pies, ducts, motors, pumps, etc. - not permitted if any asbestos is present.

2. Solder for all piping is to be lead-free.
   .1 "Lead Free" shall mean solder which contains less than 0.030% of lead when dissolved in fluoroboric and nitric acids and tested by inductively coupled argon plasma atomic emission spectroscopy. "Steelbond 281" and "Silverbrite" are acceptable solder products.
   .2 The mechanical contractor shall provide an affidavit signed by the Principal of the company, on company letterhead, that all of the solder used on the project was either one of the two acceptable products or that the solder used (identified by brand name) meets or exceeds the testing criteria.
   .3 The Owner shall undertake random testing of the soldered joints. Should testing prove that the solder used was not as specified, the Owner shall take action against the contractor to the full extent of the law.

3. All paint and finish coatings are to be lead and mercury-free. Submit Material Safety Data Sheets confirming that these products are free of all lead and/or mercury compounds.

End of Section

PART 1 - GENERAL

1.1 Related Work

1. These specifications apply to all 16 divisions of the project specification. It is the responsibility of the contractor to apply these provisions wherever practical within specification limits to all products and services used on this project.

2. It is recognized that currently specified materials and methods may conflict with the basic intention of this section. Where reasonable alternate materials and methods exist that are not specified here, and that do not compromise quality or create additional cost for the owner, notify the Architect of such alternate materials or methods. Do not proceed to use alternate materials or methods to those specified without the express approval of the Architect.

3. Elsewhere, apply the provisions of this section to all work. Exceptions can only be made when signed off by the Architect. Suitability of all products used is the responsibility of the contractor.

1.2 Compliance Specifications

1. The contractor must comply with all applicable health, safety and environmental regulations.

1.3 Beyond Compliance Specifications

1. These specifications apply in addition to all applicable health, safety and environmental compliance regulations. They are incorporated here to reflect the Owner’s intention to develop a specification which maximizes environmentally “friendly” materials and methods wherever possible within current technical and budget limitations.

2. Beyond compliance specifications recognize that performance well beyond the minimum regulatory standard is often desirable, possible and affordable, often with no cost or low cost options. It also recognizes that application methods or protocols may be as important as the material specified. Therefore these specifications cover both material and methods.

3. The primary goal of beyond compliance specification is to reduce the use of products or methods which have negative health and environmental impacts both during and after construction. These considerations may include full life cycle impacts, associated with raw materials, manufacturing, transport, deconstruction and their eventual fate.

4. These specifications will specifically address primary categories of readily identifiable products, ingredients and methods.

5. These provisions apply to both indoor and outdoor applications equally.

1.4 Exceptions

1. These specifications recognize that not all substitutes are equal and therefore exceptions can be made based on substantive evidence of necessary and superior performance. Special considerations may be given to restricted substances when secondary provisions are made such as sealed in place (contained) applications. All such exceptions must be approved in writing by the Architect.

PART 2 - MATERIALS

2.1 Products or Substances to be Avoided or Limited in Use

1. No product containing the following substances may be used on this project when an equivalent product without or with a lower concentration of this substance is suitable and available. All products containing substances which are known to cause health effects including but not limited to cancer, mutagenic, neurological, or behavioral effects should be avoided if suitable substitutes not containing or containing lower concentrations are available. This provision shall be limited to information contained on Material Safety Data Sheets, therefore MSDS sheets must be reviewed for all products for which such sheets are required. Applications for exceptions must be accompanied by related MSDS and product application and performance sheets, clearly showing a need for the exception.

2.2 Volatile Organic Compounds

1. No product containing volatile organic compounds (in over simplified terms volatile petro chemical or similar plant derived solvents) may be used on this project when a suitable non VOC or failing that a low VOC substitute is available. Manufacturers may refer to the U.S. EPA definition of VOC's for guidance or alternatively use the low molecular weight organic compound descriptor.

   Example: Paints, Coatings, Primer, Adhesives, Chalks, Firestops, etc.

2. Waterborne equivalents are available for most of the solvent borne products used in construction and in most cases would be the preferred alternative. Waterborne products may in some instances have high VOC contents, therefore the fact that a product is waterborne does not automatically make it acceptable.

2.3 Chlorinated Substances

1. Poly Vinyl Chloride (vinyl) and other chlorinated products should be avoided if suitable substitutes are available.

2.4 Plasticizers

1. Plasticisers which offgass (low molecular weight) should be avoided.

2.5 Man Made Mineral Fibres

1. Products containing mineral fibres which can be emitted or abraded should be avoided.

   Examples: duct liner, mineral fibre ceiling tiles, etc.

2.6 Radiation

1. Products or methods which result in the lowest emission of Electro Magnetic Fields are preferred.

2.7 Biocides

1. Products containing biocides (pesticides, miticides, mildeweides. fungicides, rodenticides, etc.) are not to be used if suitable alternatives are available. Highly stable, low human toxicity biocides such as Portercept may be acceptable substitutes. Biocide formulas which break down, emit powders of offgass should be avoided.

2.8 Heavy Metals

1. Heavy metals such as lead, cadmium, mercury etc. should be avoided.

2.9 Aluminum

1. Raw aluminum should be avoided, anodized or factory painted aluminum is acceptable. This is particularly applicable to surfaces which people can touch.

2.10 Ozone Depleting Substances

1. Products which contain or which use Ozone Depleting Substances such as Bromide, Chlorofluorocarbons (CFC) or Hydrofluorocarbons (HFC) etc. should be avoided if suitable substitutes are available.

2.11 Greenhouse Gasses

1. Products which contain, use or generate Greenhouse gasses such as CO2 should be avoided if suitable substitutes are available.

2.12 Bituminous (tar) Products

1. Products containing tar compounds should not be used if suitable substitutes are available.

2.13 Chemical Compounds

1. Products containing the following chemical compounds should not be used if suitable substitutes are available: Neoprene, Latex, Butyl, ABS, Formaldehyde.

2.14 Adhesives

1. Adhesives containing solvents or other non preferred ingredients should be avoided if suitable substitutes are available, including systems designs which do not need adhesives or can use mechanical etc. fastening alternatives

2.15 Composite Products

1. Some composite products contain adhesives such as formaldehyde which are not preferred, and some composites such as Fibre Reinforced Plastics are not practical for recycling. These products should be avoided if suitable substitutes are available.

2.16 Cleaners and Solvents

1. Products, equipment, and methods which require the use of cleaners and solvents are not preferred if suitable substitutes are available. Examples of preferred products would include No Wax floors, or primerless caulks and adhesives, or products not requiring caulks and adhesives.

End of Section

1. General

1. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

2. Store volatile waste in covered metal containers and remove from premises daily.

3. Prevent accumulation of waste, which create hazardous conditions.

4. Provide adequate ventilation during use of volatile or noxious substances.

5. At no time shall waste be stored inside the school building. All waste and waste containers must be separated from general public and school occupants using properly secured and locking construction hoarding.

2. Materials

1. Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

2. Provide on-site construction specific dump containers for collection of waste materials, and rubbish. The school waste bins, and garbage collection shall not be used to dispose of construction related waste materials, debris and/or rubbish.

3. Cleaning During Construction

1. Maintain project grounds, and public properties free from accumulations of waste materials and rubbish.

2. Remove waste materials, and rubbish from site.

3. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy.

4. Schedule cleaning operations so that resulting dust and other contaminants will not fall on wet, newly painted surfaces.

4. Final Cleaning

1. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all surfaces and leave project clean and ready for occupancy.

2. Employ experienced professional cleaners, for final cleaning.

3. In preparation for Substantial Performance or Fitness for Occupancy status, whichever occurs first, conduct final inspection of interior and exterior surfaces and of concealed spaces.

4. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from all interior and exterior finished surfaces; polish resilient and ceramic surfaces so designated to shine finish. Vacuum carpet.

5. Clean and polish glass and mirrors.

6. Repair, patch and touch-up marred surfaces to specified finish and to match new adjacent surfaces.

7. Broom-clean, magnet roll, and pressure wash all concrete and asphalt paved surfaces; rake clean other surfaces of grounds.

8. Clean exposed ductwork and structure.

9. Replace filters.

10. Clean bulbs and lamps and replace those burned out.

11. Clean diffusers and grilles.

12. Clean sinks, faucets, and water closets and controls.

13. Maintain cleaning until project, or portion thereof, is occupied by Owner.

End of Section

1. Requirements Included

1. Record documents, samples, and specifications.
2. Equipment and systems.
3. Product data, materials and finishes, and related information.

2. Quality Assurance

1. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

3. Format

1. Organize data in the form of an instructional manual.
2. Binders: commercial quality, 8½" x 11" maximum 2½" ring size.
3. When multiple binders are used, correlate data into related consistent groupings.
4. Cover: Identify each binder with type or printed title "Project Record Documents", list title of Project, identify subject matter of contents.
5. Arrange content 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. Drawings: provide with reinforced punched binder tab. Bind in with text, fold larger drawings to size of text pages.

4. Contents, Each Volume

1. Table of Contents: Provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
2. For each Product or System: list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
3. Product Data: mark sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
4. Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
5. Typed Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

5. Submission

1. Submit for review a digital pdf file of completed closeout documents in final form 15 days prior to substantial performance. For equipment put into use with Owner's permission during construction, submit Operating and Maintenance Manuals within 10 days after start-up. For items of Work delayed materially beyond date of Substantial Performance, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

2. Consultant comments will be returned, and the contractor is to revise the content of documents as required prior to final submittal.

3. Submit one (1) digital copy of revised volumes of data in final form within ten days after final inspection.

4. For contract drawings (architectural, landscaping, structural, mechanical, electrical), transfer neatly as-built notations onto a digital set and submit to consultant.

5. Prepare digital pdf file for submission on USB of completed closeout documents.

6. Record Documents and Samples

1. In addition to requirements in General Conditions, maintain at the site for Owner one record copy of:
   - .1 Contract 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.

2. Store Record Documents and Samples in Field Office apart from documents used for construction. Provide files, racks, and secure storage.

3. Label and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "Project Record" in neat, large, printed letters.

4. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

5. Keep Record Documents and samples available for inspection by Consultant.

7. Recording As-Built Conditions

1. The consultant will provide electronic copies of project drawings in PDF format. Make one (1) hardcopy of the project drawings for the purpose of recording as-built conditions. Mark and record changes on an on-going basis as construction proceeds. **Near the end of the construction period transfer all marks to the supplied electronic documents and submit for consultant review as project record as-built documents**.

2. Refer to drawings/specifications for additional mechanical and electrical requirements.

3. Record information concurrently with construction progress. Do not conceal work until required information is recorded.

4. Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
   .1 Measure 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.

5. Specifications: legibly mark each item to record actual construction, including:
   .1 Manufacturer, trade name, and catalog number of each project actually installed particularly optional items and substitute items.
   .2 Changes made by Addenda and Change Orders.

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

8. Digital As-Built Drawings

1. Contractor is responsible for providing red-line PDF as-builts only. Consultant contract includes for CAD record drawings.

2. After the consultant has found the Redlined As-Built drawings to be acceptable, transfer to digital file all information recorded on As-Built drawings. Layering of information as per consultant's instructions.

9. Equipment and Systems

1. Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

2. Panelboard Circuit Directories: provide electrical service characteristics, controls, and communications.

3. Include installed colour coded wiring diagrams.

4. Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instruction. Include summer, winter, and any special operating instructions.

5. Maintain Requirements: include routine procedures and guide for troubleshooting; disassembly, repair and reassemble instructions; and alignment, adjusting, balancing, and checking instructions.

6. Provide servicing and lubrication schedule, and list of lubricants required.

7. Include manufacturer's printed operation and maintenance instructions.

8. Include sequence of operation by controls manufacturer.

9. Provide original manufacturer's parts lists, illustrations, assembly drawings, and diagrams required for maintenance.

10. Provide installed control diagrams by controls manufacturer.

11. Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

12. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

13. Provide a list of the original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

14. Include test balancing reports as specified in mechanical specifications.

15. Additional Requirements: As specified in individual specification sections.

10. Materials and Finishes

1. Building Products, Applied Materials, and Finishes: include product data, with catalog number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

2. Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

3. Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommend schedule for cleaning and maintenance.

4. Additional Requirements: as specified in individual specifications sections.

11. Guarantees, Warranties and Bonds

1. Separate each warranty or bond with index tab sheets keyed to the List of Contents listing.

2. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal. Use Guarantee/Warranty Form as provided in Section 01721 whenever standard preprinted trade or manufacturer's Guarantee/Warranty forms are not available.

3. Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

4. 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.

5. Verify that documents are in proper form, contain full information, and are notarized.

6. Co-execute submittals when required.

7. Retain warranties and bonds until time specified for submittal.

End of Section

1. Notes

1. To be made out on the letterhead of Guarantor or Warrantor which usually is a Subcontractor.

2. This format is to be used only when standard preprinted trade or manufacturer's forms are not available. Preprinted forms are to include all elements of information shown on this sample or as a minimum.

3. Comply with Requirements for Guarantee/Warranty as specified in Section 01720, Article 10.

To: Hamilton Wentworth District School Board
20 Education Court
Hamilton, ON L9A 0B9

Date: _____

SECTION _____

TITLE _____

GUARANTEE/WARRANTY TO:

OWNER	Hamilton Wentworth District School Board
PROJECT	*Holbrook ES* *Gym Renovations and AHU Replacement* *Project No. P02081*
ARCHITECT	*AMRA J Architects Inc.*
REFERENCE	(to specifications or drawings)
TIME	Period of Guarantee/Warranty:_____ years
GUARANTEE/ WARRANTY	Starting Date: Substantial Performance as certified by Architect Date: _____

(Description of Guarantee/Warranty)

_____

_____

_____

Upon written notification from the Owner or the Consultant that the above work is defective any repair or replacement work required shall be to the Consultant's satisfaction at no cost to the Owner.

This guarantee shall not apply to defects caused by the work of others, maltreatment of materials, negligence or Acts of God.

SUBCONTRACTOR

_____ _____
Signature Date

Authorized Signing Officer:

_____
(Name Printed)

_____
Title

Name of Firm: _____

Address: _____

Telephone Number _____

CONTRACTOR

_____ _____
Signature Date

Authorized Signing Officer:

_____ _____
(Name Printed)

_____
Title

Name of Firm: _____ SEAL

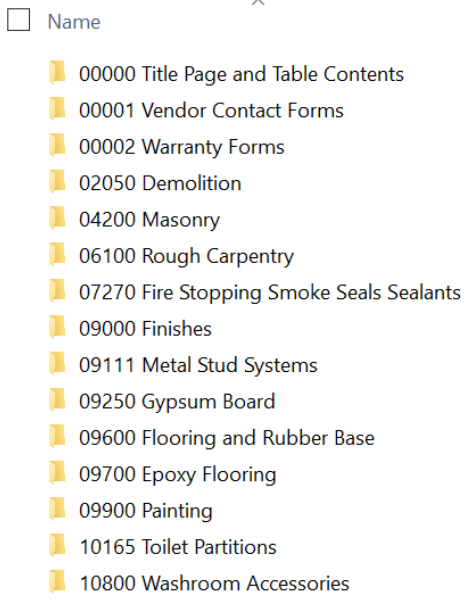
Address: _____

Telephone Number _____

End of Section

1. Maintenance Manual

1. On completion of project, submit to the Owner one (1) digital copy of Operations Data and Maintenance Manual in English, made up as follows:
   1.1. Enclose title sheet, labeled "Operation Data and Maintenance Manual", project name, date and list of contents.
   1.2. Organize content folders into applicable sections of work to parallel project specification break-down. Mark each section by labeled folder similar to the following example:



   1.3. The digital copy of all documents in the operations and manuals must be provided on a USB, format to be PDF.

2. Include the following information, plus data specified.

   .1 Maintenance instructions for finished surface and materials.
   .2 Copy of hardware and paint schedules.
   .3 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
   .4 Names, addresses and phone numbers of sub-contractors and suppliers.
   .5 Guarantees, Warranties and bonds showing:
      .1 Name and address of project.
      .2 Guarantee commencement date (date of Final Certificate of Completion).
      .3 Duration of guarantee.
      .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
      .5 Signature and seal of Contractor.
      .6 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.

3. Neatly type lists and notes. Use clear drawings, diagrams or manufacturers' literature.

4. Include in the Manuals a complete set of final shop drawings indicating corrections and changes made during fabrication and installation.

5. Include in the manuals a complete set of final as-built red line drawings. Include each drawing sheet and indicate on the title block “As-Build Drawing”

End of Section

1. General

1. **Bonds:** Refer to Supplementary General Conditions and to Standard Contract Document CCDC No. 2, 2020 for bonding requirements for this project, both at the time of tender submission and throughout the duration of the construction period.

2. Standard Warranty

1. Refer to Supplementary General Conditions and to Standard Contract Document CCDC No. 2, 2020 for warranty requirements and conditions for the standard warranty which is required for the work of this contract.

3. Extended Warranties

1. Refer to individual specification sections for requirements of extended warranties required for particular sections or items of work.

2. Extended warranties are required to be issued by manufacturers, fabricators, suppliers and/or installers, sometimes jointly, due to their unique position in the construction process and their ability to guarantee a particular section of work. Refer to individual requirements of extended warranties requested.

3. Unless specifically noted otherwise, all extended warranties shall commence on the date of Substantial Performance of the Work as certified by the Consultant.

4. All Extended Warranties shall be listed separately and included as a separate section in the operations and maintenance manuals provided to the HWDSB at project close out. Each Extended Warranty document shall include the vendor's contact information, date of warranty commencement and expiry as well as listing the specific product with extended warranty. This document shall clearly indicate if the warranty includes or excludes labour.

5. Listed below is a summary of extended warranties required for individual Sections. This list, if inconsistent with the specified requirements of individual extended warranties, shall be deemed correct with respect to the length of extended warranties. Extended warranties required shall include, but not be limited to, the following:

   Extended warranties (total warranty period listed, including entire building warranty)

Sealants (Section 07 92 00)	5 years
Painting (Section 09 91 00)	2 years

End of Section

Appendix A – Construction School Specific Information Sheet Sample

In addition to the terms and conditions of the Contract Documents, the Contractor shall follow the protocols of the Construction Site Specific Information Sheet, sample provided below.
A completed version of this document, with site specific content, will be provided to the Contractor at the pre-construction meeting.

HWDSB

Capital Projects
Facility Services

Construction School Specific Information Sheet

1. School Information:

School Name:	Insert School Name
Bell Times	
Morning (School Entry):	0:00 AM
Afternoon (School Dismissal):	0:00 PM
Aftercare Program Dismissal:	6:00 PM
Caretaking Phone Number:	000-000-0000
***After-Hours Emergency Number:**	905-667-3079
****Caretaking Hours**	
September to June	6:00 AM – 10:00 PM
December Holiday Break	6:00 AM – 2:00 PM
March Break	6:00 AM – 2:00 PM
July to August	6:00 AM – 2:00 PM
Saturday / Sunday	CLOSED
Account Code:	HP0000
Security Panel Code:	0000

*Please call the After-Hours Emergency Number noted above if issues arise outside of Caretaking Hours. These would include unanticipated interruption of services, issues with building or room access, fire alarm or security concerns, etc.

**Caretaker hours are not guaranteed. Please confirm with the HWDSB project supervisor prior to any work taking place, and then on a weekly basis throughout the duration of the project.

2. School Entry for afterhours, school holidays or closures:

Please follow these steps upon entry to the building outside of caretaker hours and on school holidays or closures:

1. Call API Alarm Inc. at 1-877-787-5237 and notify them in advance of the day(s) and time(s) that access to the building will be required. They will require the HP code noted above.
2. Disarm the security panel when arriving.
3. Arm the security panel when leaving.
4. Call API to verify that the building is armed and secure.

Failure to follow this procedure outside of caretaker hours and on school holidays or closures will result in an automatic dispatch of a security guard to the building to verify who has entered/exited the building. Security costs associated with the dispatch of a security guard for failing to follow the procedure will be expensed to the contractor responsible for the incident.

3. Protocol for Work Impacting Fire Alarm System or Devices

The contractor is to follow this guide when the fire alarm system is impacted during school renovations.

A. References and Definitions:

Fire Alarm Control and Testing Service Provider: Hamilton Fire Control

Fire Alarm and Security System Monitoring Service Provider: API Alarm Inc.

Fire Watch: An hourly patrol of the school when the fire alarm system is on bypass, in trouble, or a device is disconnected/red-capped. Contractors cover the construction area; caretakers cover the occupied school area.

Fire Watch Log: A written record of the Fire Watch, maintained separately by contractors and caretakers and kept on the school premises at all times.

B. Mandatory Pre-Construction Site Meeting with Hamilton Fire Control

1. Contractor to request a meeting prior to mobilization with Michael Fleet from Hamilton Fire Control (HFC), the project supervisor from HWDSB, the facility operation supervisor from HWDSB and the head caretaker to review any work that will affect the fire alarm system. This can be coordinated by the project supervisor upon request.

   Contact: Michael Fleet - Hamilton Fire Control
   Phone: (905) 527-7042
   Email: michael@hamiltonfirecontrol.ca

2. Contractor to minute the meeting and submit to the project supervisor and Michael Fleet from HFC for review within 48 hours of the site-walk-through.

C. Mandatory Construction Protocol if the Fire Alarm System is Impacted

1. Contractor to follow procedures discussed and documented from the pre-construction site meeting with Hamilton Fire Control.

2. If devices are impacted during occupied hours:
   - Per the Fire Safety Plan, contractor to notify API that they'll be on Fire Watch (in the area of the impacted devices only). API will not take any action; the notification is for information purposes only.
   - Contractor to either take the device offline or protect/cover it. Fire watch (in the area of the impacted device only) is required in either of these scenarios. If the alarm goes off during work, all occupants, including contractors, are to evacuate the building and the fire department will be dispatched.

   If hot work is taking place, prior to the above-noted steps:
   - Contractors are required to advise HWDSB at least 24 hours before any hot work is scheduled to take place.
   - The contractor is required to provide a hot work permit to HWDSB at the same time.

3. If devices are impacted outside of occupied hours, and the contractor is the only party in the building:
   - The same protocol above is to be followed.

4. If the system or specific devices will not be operational while the school is completely vacant (i.e. overnight or on a weekend when no Work is taking place):
   - No action required.

The system is not to be bypassed. The system is not to be put on test. The <u>only</u> time the system will be put on test and the school will be on Fire Watch is if the system is being tested.

In the event a fire alarm device is activated, all occupants of the school, including contractors, must evacuate the school. The fire department will be dispatched. The contractor will be responsible for all fire department costs resulting from construction.

4. <u>Please follow these steps for planning any service (electrical, gas, water) shutdowns:</u>

A. Internal Localized System/Service Shutdowns:

1. Localized shutdowns **<u>require minimum 3 days' notice</u>** to HWDSB project supervisor for coordination with the school facility and staff.
2. Shutdowns must be completed outside of school bell times/operational hours which vary by facility and must be scheduled for evenings after 6:00 PM, weekends or board holidays.
3. If a shutdown will impact the security system, the contractor shall contact API Alarm Inc. at 1-877-787-5237 and notify them in advance of the day(s) and time(s) of the shutdown.

4. If a shutdown impacts the fire alarm system, the contractor shall follow the Fire Alarm Bypass Protocol, section 4 above.
5. If required, the contractor is to coordinate with Board vendor/s to be on site to ensure boilers, roof top units, heat pumps, etc. are functioning properly after service disruption has concluded.

    - Chamberlain Building Services Inc - info@chbs.ca, 905-664-1914 or
    - Union Boiler Company Limited - info@unionboiler.com, 905-528-7977

6. Process will vary based on services shutdown and ability to localize shutdown.

B. Complete School System/Service Shutdowns:

1. Complete building shutdowns **require minimum 5 days' notice** to HWDSB project supervisor.
2. Shutdowns must be completed outside of school bell times/operational hours which vary by facility and must be scheduled for evenings after 6:00 PM, weekends or board holidays.
3. Contractor to contact API Alarm Inc. at 1-877-787-5237 and notify them in advance of the day(s) and time(s) of shutdown.
4. During the shutdown, the contractor is responsible for following Fire Alarm Bypass Protocol, section 4 above.
5. The contractor is to coordinate with Board vendor/s to be on site to ensure boilers, roof top units, heat pumps, etc. are functioning properly after service disruption has concluded.

    - Chamberlain Building Services Inc - info@chbs.ca, 905-664-1914 or
    - Union Boiler Company Limited - info@unionboiler.com, 905-528-7977

6. HWDSB project supervisor will coordinate with other HWDSB departments to ensure all systems (IIT, security, communications) are up and running after service disruption has concluded.
7. If required, HWDSB project supervisor will coordinate with City of Hamilton staff if site has shared facilities such as recreation centre, community centre, pool or library, etc.
8. Process will vary based on service shutdown.

C. Heating and Cooling System Shutdowns:

1. Heating and cooling system shutdowns **require minimum 5 days' notice** to HWDSB project supervisor
2. Shutdowns must be completed outside of school bell times/operational hours which vary by facility and must be scheduled for evenings after 6:00 PM, weekends or board holidays.
3. The contractor is to coordinate with Board vendor/s to be on site to ensure boilers, roof top units, heat pumps, etc. are functioning properly after service disruption has concluded.

- Chamberlain Building Services Inc - info@chbs.ca, 905-664-1914 or
- Union Boiler Company Limited - info@unionboiler.com, 905-528-7977

4. If the boiler system is drained, the contractor upon refilling the system, is responsible for coordinating Board approved chemical treatment vendor to treat water.

   - Aquarian Chemicals Inc - info@aquarianchemicals.com, 905-825-3711

5. Process will vary based on services shutdown and ability to localize shutdown.

D. Asbestos Abatement and Designated Substance Related Work:

1. Designated substance related work **requires minimum 5 days' notice** to HWDSB project supervisor.
2. Designated substance related work in occupied areas must be completed outside of school bell times/operational hours which vary by facility and must be scheduled for evenings after 6:00 PM, weekends or board holidays.

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Provide selective removal in phases, including but not limited to following:

1.1.1.1. Acoustical ceilings including tee bars, suspension and support framing, light fixtures, exit signs and speakers.

1.1.1.2. Gym & Storage Flooring.

1.1.1.3. Removal of gym accessories as noted on the drawings

1.1.1.4. Millwork modifications as shown in drawings

1.1.1.5. Items for Salvage: as noted on drawings

1.2. REFERENCES

1.2.1. Review "Designated Substance Report" and take appropriate precautions.

1.2.2. Definitions:

1.2.2.1. Hand Demolition: Systematic demolition of structures by workers using hand-held tools.

1.2.2.2. Mechanical Demolition: Systematic demolition of structures using powered equipment.

1.2.2.3. Systematic Demolition: Methodical dismantling of structure piece by piece, usually carried out in reverse order of construction.

1.2.2.4. Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.

1.3. ADMINISTRATIVE REQUIREMENTS

1.3.1. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, inspection of construction to be demolished, methods to be used, sequence and quality control, Project staffing, restrictions due to environmental protection requirements and other matters affecting demolition, to permit compliance with intent of this Section.

1.3.2. Scheduling:

1.3.2.1. Where practicable, remove or neutralize hazardous or toxic materials before demolition begins.

1.3.2.2. Phase selective demolition to be coordinated with Owner’s on-going occupancy of the school.

1.4. QUALITY ASSURANCE

1.4.1. Comply with National Building Code, Part 8, Construction Safety Measures at Construction and Demolition Sites

1.4.2. Do work in accordance with CSA S350 and comply with pertinent codes, regulations and insurance carriers providing coverage for this work.

1.4.3. Execute the work in strict accordance with The Occupational Health and Safety Act and Regulations for Construction Projects, latest addition. Keep copy of the Act at the place of the Work at all times.

1.4.4. Restrictions: Restrict demolition activities to hours in accordance with Section 01 10 00 - Project Administrative Requirements.

1.5. SITE CONDITIONS

1.5.1. Demolition performed on this Project in school areas adjacent to occupied areas. Every part of the demolition work must be carefully planned, scheduled, and coordinated with the HWDSB Protect Manager, including:

1.5.1.1. Hours of operation

1.5.1.2. Dust control, infection prevention and control.

1.5.1.3. Disruption to existing mechanical or electrical services, fire alarm, sprinkler, communications systems.

1.5.1.4. Noise control.

1.5.1.5. Protection to existing building

1.5.1.6. Access to the work area including procedures for movement and removal of materials.

PART 2 - PRODUCTS

2.1. MATERIALS

2.1.1. Description:

2.1.1.1. Regulatory Requirements:

2.1.1.1.1. Conform to The Occupational Health and Safety Act and Regulation for Construction Projects

2.1.1.1.2. Conform to OBC, especially Division C, Part 1, Article 1.2.2.3 as applicable.

2.1.1.1.3. Conform to Fire Code, Regulation under Fire Marshal Act especially Part 8.

2.1.2. Materials and Products Removed From Existing Building

2.1.2.1. Refer to drawings for existing items that are designated to be carefully removed and reinstalled or relocated.

2.1.2.2. Refer to drawings for existing items that are to be carefully removed and handed over to the Owner.

2.1.2.3. Materials resulting from demolition and not required to be retained shall be removed promptly from site in accordance with requirements of authorities having jurisdiction and in safe manner to minimize danger at site and during disposal.

2.1.2.4. Materials that are to be removed from the site and can be reused should be sent to the appropriate facility.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Review audit of hazardous materials and designated substances of existing construction provided by Owner.

3.1.2. Consultant does not guarantee that existing conditions are the same as those indicated in Construction Documents.

3.1.3. Preliminary Survey:

3.1.3.1. Before commencing demolition operations, examine building to determine type of construction, condition of structure and site conditions. Assess strength and stability of damaged or deteriorated structures.

3.1.3.2. Assess potential effect of removal of any part or parts on remainder of structure before such part(s) are removed.

3.1.3.3. Investigate for presence of hazardous materials not identified in the construction documents.

3.1.3.4. Prepare a complete photographic record of all finishes and equipment to remain. Note any damages, missing items, breaches in fire rated construction, potential hazardous materials, conditions that are different from what is shown in the Construction Documents, and any other items of concern that could impact the construction. Submit report of existing conditions before start of demolition operations, for each work area.

3.1.4. Existing Services:

3.1.4.1. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.

3.1.4.2. Identify all services and systems exposed as part of the demolition.

3.1.4.3. Verify services are cut off and properly capped before commencing associated or effected demolition.

3.1.4.4. Provide and maintain temporary fire alarm and fire protection services required during demolition to satisfaction of authorities having jurisdiction, fire departments and HWDSB Project Manager.

3.1.4.5. Verify prior to commencement work of this Section that disconnection and capping of electrical and mechanical services have been carried out.

3.1.4.6. Verify that dust control hoardings have been completed, inspected and accepted before proceeding.

3.2. PREPARATION

3.2.1. Protection of In-Place Conditions:

3.2.1.1. Post suitable warning signs outside of work area for protection of staff and public. Supervise entrance to work area to prevent entrance by unauthorized persons. If requested, provide lockable doors to prevent public entering danger zone.

3.2.1.2. Post warning signs on electrical lines and equipment which must remain energized to serve other portions of the building during period of demolition.

3.2.1.3. Provide fire extinguishers acceptable to fire prevention authorities in locations and of type suitable to enable personnel to deal with fire occurring during progress of work.

3.2.1.4. Provide suitable protection to existing lockers, doors, walls and finishes to remain. This includes a sealed 6 mil poly cover to prevent dust getting into equipment and fixtures.

3.2.2. Environmental Protection:

3.2.2.1. Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.

3.2.2.2. Removal of all demolition materials shall be in sealed containers.

3.2.3. Protection to Existing Services:

3.2.3.1. Provide protection required to enable existing building services, systems and equipment to remain in continuous and normal operations.

3.2.3.2. Demolition shall be carried out in a manner to ensure the minimum of disruption to Owner, and other contractors working in the building.

3.3. DEMOLITION — GENERAL

3.3.1. Execute work in conformance to Hamilton Wentworth School Board Standards. Notify HWDSB Project Manager before disrupting building access or services.

3.3.2. Carry out demolition in accordance with CSA S350-M. Demolish structure and remove materials from site. Use hand tools only. Adhere to manufacturer's recommendations in use of hand held tools while conforming to the Occupational Health and Safety Act requirements.

3.3.3. Do not demolish spray or trowel-applied friable materials, materials suspected of containing PCBs or other hazardous materials. Where such materials are encountered notify HWDSB Project Manager immediately. Do not proceed until instructions have been received from Consultant.

3.3.4. Remove mechanical and electrical items indicated to be removed. Remove all abandoned services, communication lines, electrical wiring, plumbing, and ductwork.

3.3.5. The use of pneumatic or electrical jack hammers is not permitted.

3.3.6. Report any existing conditions uncovered by the demolition work that require remediation. This includes:

3.3.6.1. Damaged or unsafe services.

3.3.6.2. Unsupported services, structural members or missing hangers.

3.3.6.3. Incomplete insulation, vapour retarder or air barrier.

3.3.6.4. Incomplete or unacceptable fire separation, missing seals, fire dampers, fireproofing or firestopping.

3.3.7. Minimize noise. Avoid use of noisy equipment. Proposed methods for demolition to be reviewed at the pre-construction meetings ahead of the work in each work area.

3.3.8. Firestopping and Smoke Seal: In event work of this Section impacts on integrity of fire separations, ensure trade performing firestopping is notified.

3.3.9. Demolition for new services:

3.3.9.1. Cut openings through existing walls, partitions, roofs and floors. Establish exact location of steel reinforcing and conduits in existing concrete slabs or walls before cutting. Locate using non destructive, non ionizing radio frequency locators, magnetic scanning or X-ray. Scanning procedures and proposed methods and equipment to be reviewed with HWDSB Project Manager before proceeding. Be responsible for damage to existing steel reinforcing and be liable for structural failure.

3.3.9.2. Neatly cut openings and holes plumb, square and true to dimensions required. Use cutting methods least likely to damage remaining or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3.3.9.3. Openings to allow passage of ducts shall be closed tight to perimeters of duct at all locations where fire dampers are required.

3.3.10. Where items are to be removed from existing structure or surfaces that are to remain in place, remove those items complete with hangers, brackets and other readily removable supports and fastenings:

3.3.11. Building Services:

3.3.11.1. Arrange with HWDSB Project Manager to disconnect or interrupt existing building services. Cut-off and cap existing building services under Owner's supervision.

3.3.11.2. Coordinate with Mechanical and Electrical respectively for removal, relocation and reinstallation of mechanical and electrical items.

3.3.11.3. Prevent demolition debris from entering building drains.

3.3.12. Relocation of Salvaged Items:

3.3.12.1. Carefully remove, store, protect and re-install where applicable existing materials and equipment noted on Drawings to be retained and relocated. Relocate items to be retained and store them in areas directed by Consultant. In addition to items indicated on Drawings, Owner still reserves the right to retain any items or materials.

3.4. REMOVAL OF CEILINGS

3.4.1. Remove existing ceilings as shown in drawings. Acoustical ceiling panels and electrical light fixtures to be recycled rather than disposed as waste, as much as possible.

3.4.2. Support structure for ceiling systems including hangers and framing used for support of light fixtures shall be removed.

3.4.3. Carefully remove exit signs, speakers and other ceiling mounted fixtures.

3.4.4. Provide temporary support as required for sprinklers, fire alarm bells, smoke and heat detectors, and HVAC ductwork.

3.4.5. Take precautions to adequately support structure, provide bracing required for safety and execution of the work. Coordinate with structural requirements.

3.5. REMOVAL OF RESILIENT FLOOR FINISHES

3.5.1. Remove vinyl composite tile where shown. Strip all adhesive, underlayment or other cleavage membranes.

3.5.2. Remove resilient base.

3.5.3. Coordinate surface preparation of concrete slab with flooring trades in Division 09. Leave substrate flush, smooth and level suitable for new floor finish.

3.6. EXISTING SLAB PREPARATION

3.6.1. Remove existing floor finishes and bases as noted above.

3.6.2. At existing locations where flooring and base, has been removed, where concrete curbs, bases, steps and pads have been removed, grind and patch existing concrete slabs as required and clean slab and base surfaces, remove ridges, bumps, adhesives and other matter detrimental to bond of levelling coat, new finish application or underlayment. Surfaces shall be smooth, level and free of gouges; prepare for levelling coat and/or new finish application specified in respective Sections or underlayment.

3.6.3. At existing locations designated to receive new flooring, remove paint, old adhesives, and hard applied finishes by grinding or other approved means, as required to accommodate new flooring. Prepare for flooring application. Coordinate requirements with Work specified in flooring Sections.

3.6.4. At existing locations where slabs have been contaminated with oil, grease, resins or other such material not compatible with subsequent applied underlayment or flooring, remove contaminants by blast tracking or prepare existing surfaces by other approved means.

3.6.5. Rinse subfloor and vacuum clean.

3.7. MISCELLANEOUS DEMOLITION

3.7.1. Remove heaters items, tack boards, chalk boards, notice boards, washroom accessories, fitments, projectors and screens, and other such components as indicated on the drawings.

3.7.2. Remove fixtures, tracks, shelves, doors, frames, and railings that are attached to partitions and ceilings identified to be removed in the drawings.

3.8. CUTTING AND PATCHING

3.8.1. Obtain Consultant's approval before cutting, boring or sleeving load-bearing members.

3.8.2. Cut and patch as required to make work fit.

3.8.3. Make cuts with clean, true, smooth edges.

3.8.4. Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.

3.8.5. Patch openings created where mechanical and electrical services are removed in existing building.

3.8.6. Use specialists in affected materials to execute cutting, fitting and remedial work.

3.8.7. Make good surfaces exposed or disturbed by work with material and finish to match existing adjoining surfaces.

3.9. CLEANING

3.9.1. Waste Management:

3.9.1.1. Clear away dirt, rubbish and loose litter resulting from work of this Section, minimum daily. Keep dust to a minimum. When necessary and practical demolition works shall be sprayed periodically with water to reduce dust. Wet down debris from time to time to control dust.

3.9.1.2. Selling or burning of materials on site is not permitted.

3.9.1.3. Conform to requirements of authorities having jurisdiction regarding disposal of waste materials.

3.9.1.4. Materials prohibited from municipality waste management facilities shall be removed from site and dispose of at recycling companies specializing in recyclable materials.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Work requirements for flooring restoration including but not limited to following:

1.1.1.1. Repair existing masonry units where indicated in the drawings

1.2. REFERENCES

1.2.1. Abbreviations and Acronyms:

1.2.1.1. OMCA: Ontario Masonry Contractors' Association; www.canadamasonrycentre.com.

1.2.2. Reference Standards:

1.2.2.1. ASTM C270-24 - Standard Specification for Mortar for Unit Masonry

1.2.2.2. CAN/CSA-A179-14 (R2024) - Mortar and grout for unit masonry

1.2.2.3. CSA A3000:23 - Cementitious materials compendium

1.3. ADMINISTRATIVE REQUIREMENTS

1.3.1. Pre-Installation Meetings:

1.3.1.1. Prior to commencement of work, arrange for Project site meeting of all parties associated with work of this Section in accordance with project meetings specified in Section 01 10 00 - Project Administrative Requirements.

1.3.1.2. Include Contractor, Installers performing work of this Section, subcontractors installing finishes over these products (if applicable).

1.3.1.3. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of placement and other matters affecting construction.

1.4. SUBMITTALS

1.4.1. Submittals in accordance with Submittal Procedures specified in Section 01 10 00 - Project Administrative Requirements.

1.4.2. Product Data:

1.4.2.1. Submit manufacturer's Product data. Include product characteristics and performance criteria.

1.4.2.2. Safety: Provide WHMIS Material Safety Data Sheets.

1.5. QUALITY ASSURANCE

1.5.1. Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.5.2. Membership in good standing in OMCA.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Storage and Handling Requirements:

1.6.1.1. Handle, stack and store masonry units to avoid chipping, protect against staining and moisture entry.

1.6.1.2. Do not store or locate materials, plant and equipment in areas which will obstruct access to work by others.

1.7. SITE CONDITIONS

1.7.1. Ambient Conditions:

1.7.1.1. Provide uniformly distributed and continuous heating. Prevent stratification and cold spots.

1.7.1.2. Maintain masonry continuously at minimum 4 deg C (39 deg F) during placement and for 48 hours after placement.

1.7.1.3. Employ protection and heating methods which will prevent evaporation of moisture from masonry during curing.

PART 2 - PRODUCTS

2.1. MATERIALS

2.1.1. Replacement Concrete Masonry Unit (CMU): To match existing concrete block in all respects, modular size, with special shapes and sizes as detailed.

2.1.1.1. Acceptable Products: “Carbon Cure®” by Brampton Brick Limited, Permacon, or “Autoclave Block” by Day & Campbell Limited or “Carbo Cure” by Richvale

2.1.2. Ensure exposed surfaces are free of cracks, chips or other blemishes and broken corners. Include required sash blocks for control joints, solid block where noted and concrete block lintels over openings in concrete block walls unless steel lintels are shown.

2.1.3. Cement:

2.1.3.1. Portland cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10). For exposed mortar, maintain uniformity of cement manufacturer and batch for colour uniformity.

2.1.3.2. Masonry cement: to CAN/CSA-A3000 and CAN/CSA A179, Type N for non load bearing and and Type S for load bearing.

2.1.4. Hydrated lime: to CAN/CSA A179, Type S.

2.1.5. Sand: Clean, sharp, washed and conforming in all respects to requirements of CAN/CSA-A179.

2.1.6. Course aggregate to CAN/CSA A179.

2.1.7. Water for Mortar Mixing: Potable, free from any deleterious substances.

2.1.8. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification, for job-mixed mortar; and ASTM C1142 for ready-mixed mortar.

2.1.9. Control Joints (Movement Joints) Filler: PVC control joint filler purpose designed for concrete masonry unit construction.

2.1.9.1. Durometer hardness between of 85 +/- 5 tested to ASTM D2240 of sizes and shapes required.

2.1.9.2. Acceptable products:

2.1.9.2.1. “VS Series PVC Control Joint” by Blok-Lok Limited.

2.1.9.2.2. “PVC Control Joint” by Masonpro Inc.

2.1.9.2.3. “PVC Control Joint” by Wire-Bond.

PART 3 - EXECUTION

3.1. PREPARATION

3.1.1. Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

3.1.2. Thoroughly clean surfaces by scrubbing to remove dirt, dust, and wax. Use stripper in accordance with manufacturer’s printed instructions.

3.1.2.1. Remove dirty solution with wet vacuum or mop.

3.1.2.2. Rinse with clean water and allow to dry thoroughly.

3.1.3. Establish and protect lines, levels, and coursing.

3.1.4. Protect adjacent materials from damage and disfiguration.

3.2. GENERAL REQUIREMENTS

3.2.1. Workmanship:

3.2.1.1. Build masonry plumb, level, and true to line, with vertical joints in proper alignment. Do masonry work in accordance with CSA S304, CSA A370 and CSA A371.

3.2.1.2. Do masonry mortar and grout work in accordance with CSA A179 except where otherwise specified.

3.2.1.3. Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.2.2. Remove and replace existing masonry units that are loose, chipped, broken, stained, or otherwise damaged. Install new CMU to match existing; install in fresh mortar or grout, pointed to eliminate evidence of replacement.

3.2.3. Pointing: During the tooling of joints, enlarge voids and holes and completely fill with mortar. Point-up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of paint.

3.3. LAYING MASONRY UNITS

3.3.1. Install products in accordance with product manufacturer’s written requirements.

3.3.2. Provide control joints between new and existing concrete unit masonry. Do not tooth new CMU walls into existing block walls.

3.3.3. Coursing Design: To match existing. When new work is not attached to existing construction, half running bond for concrete masonry units with vertical joint in each course centered on units in courses above and below.

3.3.4. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with existing construction.

3.3.5. Locate bearings and piers as Indicated on drawings. Provide solid masonry units at bearings. Grout under bearing plates installed on masonry with non-shrink grout.

3.3.6. Extend masonry and partitions to deck, slab or structural members, except where otherwise noted in the drawings. Incorporate both lateral support and deflection space at termination of walls as required.

3.3.7. Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, and deep or excessive furrowing of mortar joints are not permitted.

3.3.8. Fully bond intersections, and external corners.

3.3.9. Tool with non-staining pointing tool to provide smooth, compressed, uniformly formed joints:

3.3.9.1. Concave for concrete unit masonry exposed to view.

3.3.9.2. For concrete unit masonry concealed from view:

3.3.9.2.1. Strike flush joints concealed in walls and joints in walls to receive plaster, stucco, tile, insulation, resilient bases, or other applied material except paint or similar thin finish coating. Ensure that no mortar protrudes from joints on wall surfaces to receive materials and coatings.

3.3.10. Maintain mortar joint thickness of 9 mm (3/8”), unless otherwise specified or indicated on drawings. Not to exceed 12 mm (1/2”).

3.3.11. Form control joints in concrete masonry as follows:

3.3.11.1. Fit bond-breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.

3.3.11.2. Install temporary foam plastic filler in head joints and remove when unit masonry is complete.

3.4. INSTALLATION OF TUCK POINTING MORTAR

3.4.1. Repointing and Tuckpointing: Repoint defective joints as follows:

3.4.1.1. Cut back joints 13 mm (1/2") taking care not to damage units. Remove dust and loose materials by brushing or by water jet. If water jet is used, allow excess water to drain before repointing.

3.4.1.2. Repoint with same mix and colour as original.

3.4.1.3. Pack mortar tightly in thin layers and tool joint to match non-defective joints.

3.4.2. Immediately prior to application of mortar, dampen joints to be tuck pointed. Prior to application of pointing mortar, allow masonry units to absorb surface water.

3.4.3. Tightly pack mortar into joints in thin layers, approximately 6 mm (1/4”) thick maximum.

3.4.4. Allow layer to become "thumbprint hard" before applying next layer.

3.4.5. Pack final layer flush with surfaces of masonry units. When mortar becomes "thumbprint hard", tool joints.

3.5. REPLACEMENT OF MASONRY UNITS

3.5.1. Cut out mortar joints surrounding masonry units to be removed and replaced as follows:

3.5.1.1. Units removed may be broken and removed, providing surrounding units to remain are not damaged.

3.5.1.2. Once units are removed, carefully chisel out old mortar and remove dust and debris.

3.5.1.3. If units are located in exterior wythe of a cavity or veneer wall, exercise care to prevent debris falling into cavity.

3.5.2. Dampen surfaces of surrounding units before new units are placed as follows:

3.5.2.1. Allow existing masonry to absorb surface moisture prior to starting installation of new replacement units.

3.5.2.2. Butter contact surfaces of existing masonry and new replacement masonry units with mortar.

3.5.2.3. Centre replacement masonry units in opening and press into position.

3.5.2.4. Remove excess mortar with a trowel.

3.5.2.5. Point around replacement masonry units to ensure full head and bed joints.

3.5.2.6. When mortar becomes "thumbprint hard", tool joints.

3.6. CLEANING

3.6.1. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.

3.6.2. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

3.6.3. Protect masonry and adjacent work from damage from cleaning work.

3.6.4. Clean masonry in strict accordance with masonry manufacturer's printed instructions and referenced standards. Remove masonry and install new masonry if masonry is damaged by cleaning work.

3.6.5. Soak wall with clean water and flush off loose dirt and mortar.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Provide architectural woodwork including but not limited to following:

1.1.1.1. Wood casework.

1.2. REFERENCES

1.2.1. Abbreviations and Acronyms:

1.2.1.1. AWMAC/WI: Architectural Woodwork Manufacturers Association of Canada/Woodwork Institute; www.awmac.com.

1.2.1.2. NAAWS: North American Architectural Woodwork Standards

1.2.2. Reference Standards:

1.2.2.1. ANSI/BHMA A156.9-2020 – Cabinet Hardware

1.2.2.2. ANSI/BHMA A156.18-2020 - Materials And Finishes

1.2.2.3. ANSI/NPA A208.1-2022 - Particleboard

1.2.2.4. ANSI/NEMA LD 3-05 - High-Pressure Decorative Laminates

1.2.2.5. CAN/ULC-S102-18-REV1 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.2.2.6. CSA O121-17(R2022) - Douglas Fir Plywood

1.2.2.7. CSA O151-09(R2022), Canadian Softwood Plywood

1.3. ADMINISTRATIVE REQUIREMENTS

1.3.1. Preinstallation Meetings:

1.3.1.1. Conduct a pre-installation meeting in accordance with Division 01.

1.3.1.2. The following minimum items shall be reviewed at the pre-installation meeting:

1.3.1.2.1. Verify project requirements.

1.3.1.2.2. Review installation conditions under which work is to be performed including possible site concerns.

1.3.1.2.3. Review locations of backing required for millwork installation as shown on millwork shop drawings.

1.3.1.2.4. Review method of attachment for backing to wall system as shown on architectural drawings.

1.3.1.2.5. Coordination requirements with other subtrades.

1.3.2. Coordination:

1.3.2.1. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

1.4. SUBMITTALS

1.4.1. Shop Drawings:

1.4.1.1. Submit Shop Drawings for work of this Section in accordance with Section 1 of NAAWS.

1.4.1.2. On casework and countertop elevations show location of backing required for attachment within walls.

1.4.1.3. Clearly indicate material being supplied and show connections, attachments, reinforcing, anchorage and location of exposed fastenings.

1.4.1.4. Clearly indicate material being supplied.

1.4.2. Samples: Submit samples in following sizes:

1.4.2.1. Minimum 300 mm (12") long x 300 mm (12") wide x 25 mm (1") thick solid wood.

1.4.2.2. Minimum 300 mm (12") square and of specified thickness, veneer mounted on 19 mm (3/4") particle board and finished as specified.

1.4.2.3. Each type of hardware.

1.4.2.4. Each plastic laminate in manufacturer's standard chip size.

1.4.2.5. Minimum 300 mm (12") square x 25 mm (1") thick counter top materials.

1.5. QUALITY ASSURANCE

1.5.1. Qualifications:

1.5.1.1. Provide work of this Section in accordance with NAAWS produced by AWMAC/WI, except as specified otherwise herein and by reference are hereby made a part of this Section. Ensure any reference to grades and terminology in this Section is as defined in NAAWS.

1.5.1.2. Requirements of this Section govern and modify NAAWS.

1.5.1.3. Woodwork Manufacturer Qualifications:

1.5.1.4. Minimum 5 years of production experience similar to this project, whose qualifications indicate ability to comply with requirements of this Section.

1.5.1.5. Minimum one project in past 5 years where value of woodwork within 20 percent of cost of woodwork for this Project.

1.5.1.6. Installers:

1.5.1.6.1. Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Delivery and Acceptance Requirements:

1.6.1.1. Do not deliver finished Products during rainy or damp weather.

1.6.1.2. Do not deliver work of this Section until building and storage areas are sufficiently dry so Products will not be damaged by excessive changes in moisture content.

1.6.1.3. Deliver Products of this Section in accordance with Section 2, Rule 2.4.4.1 of NAAWS.

1.6.1.4. Do not deliver damaged Products.

1.6.2. Storage and Handling Requirements:

1.6.2.1. Store and handle Products of this Section in accordance with Section 2, Rules 2.4.4.2 and 2.4.4.3 of NAAWS.

1.6.2.2. Cover finished plastic laminate surfaces and varnished surfaces with heavy kraft paper and put in cartons for protection. Protect installed plastic laminate surfaces by acceptable means. Do not remove protective covers until immediately prior to final cleaning.

1.6.2.3. Maintain indoor temperature and humidity within range recommended by AWMAC's Standards (NAAWS).

1.7. WARRANTY

1.7.1. Manufacturer Warranty: Warrant work of this Section for a period of 2 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Owner.

1.7.2. Defects include but are not limited to, delamination of plastic laminate, opening of seams, warpage and extensive colour fading.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. High Pressure, Paper Base, Decorative Laminates (PL):

2.1.1.1. Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

2.1.1.1.1. Arborite; www.arborite.com

2.1.1.1.2. Formica Inc.; www.formica.com

2.1.1.1.3. Industrial Laminates/Norplex, Inc.; www.micarta.com

2.1.1.1.4. Nevamar Company, LLC; www.nevamar.com

2.1.1.1.5. Pionite Decorative Laminates; www.pionite.com

2.1.1.1.6. Wilsonart Canada; www.wilsonart.com

2.2. PERFORMANCE/DESIGN CRITERIA

2.2.1. Work in conformance with the Architectural Woodwork Manufacturer's Association of Canada Quality Standards Manual 4.0

2.2.2. Materials, methods, construction and installation to be in accordance with AWMAC Standards for Custom Grade, except as modified in these specifications.

2.2.3. Ensure millwork (e.g. countertops, wall cabinets, etc.) are capable of supporting structural loads without deflection in accordance with "casework integrity" in "Appendix" of NAAWS.

2.3. MATERIALS

2.3.1. Framing Lumber: Select Merchantable Western White Spruce, kiln dried, or sound material of any species may be used for concealed members, free from sap, shakes, knots, splits and other defects.

2.3.2. Architectural Lumber: Clear, straight, kiln dried, Select Yellow Birch for fitments and door jambs. Provide kiln dried lumber to 7% moisture content, free from blemishes that would be apparent after finish is applied.

2.4. PANEL MATERIALS

2.4.1. Panel material schedule; except where indicated or specified otherwise:

2.4.1.1. Thickness: 19 mm (3/4"), minimum.

2.4.1.2. Maximum moisture content at time of installation: 10% to 12%.

2.4.2. Plywood:

2.4.2.1. Backing grade, veneer core:

2.4.2.1.1. Softwood plywood to CSA O151

2.4.2.1.2. Douglas Fir plywood to CSA O121.

2.4.3. Particleboard; medium density:

2.4.3.1. Industrial grade, medium density particleboard core of minimum 720 kg/m3 (45 lbs/cu ft) density conforming to ANSI/NPA A208.1, Grade R, sanded both sides.

2.4.4. Particle board; fire retardant:

2.4.4.1. To ANSI A208.1-1999, FSC certified, no added urea-formaldehyde used in composition, and 100% recovered and recycled fibre and as follows:

2.4.4.1.1. Flame Spread: Class A Flame Spread 25 or under, to CAN/ULC-S102-03.

2.5. PLASTIC AND COMPOSITE MATERIALS

2.5.1. Melamine:

2.5.1.1. Conforming to ANSI A208.1, grade M3, 19 mm (3/4") minimum thick, complete with matching non-yellowing edge trim, unless otherwise noted.

2.5.2. High Pressure, Paper Base, Decorative Laminates (PL):

2.5.2.1. To ANSI/NEMA LD 3, classified as general purpose grade (HGS) (both horizontal and vertical trades) and post forming grade (HGP) (both horizontal and vertical grades).

2.5.2.2. Provide types and thicknesses conforming to ANSI/NEMA LD 3 and Section 4, “Table: 4-046 – HPDL TYPES and Minimum Performance Requirements” of NAAWS.

2.5.2.3. Plastic Laminate Adhesive: Provide in accordance with Section 4, Rule 4.4.4.6.4 and “adhesive usage guidelines” in “Appendix” of NAAWS.

2.6. FASTENERS AND ADHESIVES

2.6.1. Fasteners:

2.6.1.1. Wood screws: FF-S-111D Amendment 1 (1989), type, size, material and finish as required for the condition of use.

2.6.1.2. Nails: FED FF-N-105, type, size material and finish as required for the condition of use.

2.6.1.3. Anchors: Type, size material and finish as required for the condition of use.

2.6.1.4. Fastening devices shall be set or countersunk flush with surface of framing member. No exposed fasteners permitted. Exposed fasteners shall be flat head hex socket cap screws and matching joint connector sex bolts (also known as Chicago screws or post and screw) by Murakoshi, distributed by Richelieu, Spaenaur Joint Connector bolt with decorative head, hex drive series.

2.6.1.5. At butt joints in railing caps and counter surfaces, employ assembling bolts to ensure tight structural joint.

2.6.2. Adhesives: Moisture resistant complying with FS MMM-A-125, Type II, or FED MMM-A- 188, Type I, II or III; type best suited for the purpose.

2.7. HARDWARE

2.7.1. Casework hardware: to ANSI/BHMA A156.9-2003.

2.7.1.1. Shallow Drawer Slides: “1375” by Knape & Vogt Manufacturing Company; www.knapeandvogt.com or “3832” by Accuride; www.accuride.com, full extension type with a capacity of 34 kg (75 lb).

2.7.1.2. Deep Drawer Slides: “1485” by Knape & Vogt Manufacturing Company or “4005” by Accuride, full extension type with a capacity of 68 kg (150 lb).

2.7.1.3. Recessed Shelf Pilasters, Standards and Clips: Provide “KV255" pilaster and “KV256" clip supports by Knape & Vogt Manufacturing Company; www.knapeandvogt.com or “120-10 Series” pilasters and “1903-2G” clip supports by Richelieu Hardware Ltd.; www.richelieu.com.

2.7.1.4. Concealed Hinges: “Euromat Topsafe” by Hettich Canada L.P.; www.hettich.com, minimum 170 degree opening angle and is self closing. Supply manufacturer's recommended number of hinges to suit door size and thickness.

2.7.1.5. Wire Pulls (Doors and Drawers): “CBH 220" by Canadian Builders Hardware Mfg. Inc.; www.cbhmfg.com, 100 mm (4").

2.7.1.6. Knobs (Doors and Drawers): “BK.K771.PB” by Belwith Keeler; www.belwithkeeler.net, brass in 32 mm (1-1/4") diameter.

2.7.1.7. Door Locks: Keyed cylinder cam lock type C4 (satin brass, clear coated on brass base) finish.

2.7.1.8. Drawer Locks: “0738 Drawer Lock” by CCL Security Products; www.cclsecurity.com, C4 (satin brass, clear coated on brass base) finish.

2.7.1.9. Plastic Hooks: “HC.H 520" by Hewi; www.hewi.com, 100 mm (4") in size.

2.7.1.10. Closet Coat Rods: “KV660" 27 mm (1-1/16") od stainless steel rod complete with “KV734" and “KV735" polished chrome flanges by Knape & Vogt Manufacturing Company; www.knapeandvogt.com. Size rods to suit closet widths.

2.7.1.11. Grommets: “Round Grommets" by Richelieu Hardware Ltd.; www.richelieu.com, 63 mm (2-1/2") drilling diameter, black in colour. Provide 4 grommets per workstation and locate as directed by Province.

2.7.2. Hardware finish:

2.7.2.1. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18-2006 for BHMA finish number indicated.

2.7.2.1.1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base.

2.7.2.1.2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.

2.7.2.1.3. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.

2.7.2.1.4. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2.7.2.1.5. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.

2.7.2.1.6. Satin Stainless Steel: BHMA 630.

2.7.2.2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9-2003.

2.8. FABRICATION

2.8.1. General:

2.8.1.1. Materials and methods of construction to meet requirements of AWMAC’s Standards (NAAWS) for Custom grade.

2.8.1.2. Fabricate joints accurately fitted, coped where possible and well glued up. Fabricate joints mitred to perfect fit and alignments carefully matched.

2.8.1.3. Fabricate finished woodwork in 1 piece where possible. Fabricate running members in the longest lengths obtainable.

2.8.1.4. Fabricate to conceal fastenings.

2.8.1.5. Provide plastic laminate work in shop where practical and/or possible.

2.8.1.6. Fabricate exposed gables to match the required exposed finishes.

2.8.2. Plastic Laminate Millwork:

2.8.2.1. Construction Type: Frameless.

2.8.2.2. Cabinet and door interface: flush overlay.

2.8.2.3. Exposed Surfaces HPDL, color, finish and pattern direction color and pattern as selected by Consultant and meeting requirements of AWMAC's Standards (NAAWS) for Grade specified.

2.8.2.4. Exposed interior surfaces: LPDL of a color and pattern as selected by Consultant.

2.8.2.5. Semi-exposed surfaces: LPDL of a color and pattern as selected by Consultant.

2.8.2.6. Edgeband: PVC

2.8.3. Drawers:

2.8.3.1. Sides: Particle board with LPDL surfaces.

2.8.3.2. Bottoms: MDF with melamine surfaces.

2.8.3.3. Joinery: Meeting requirements of AWMAC's Standards (NAAWS) for Grade specified.

2.8.4. Countertops:

2.8.4.1. Fabricate and assemble countertops and splashbacks in shop to profiles and lengths required.

2.8.4.2. Fabricate cutouts for services penetrations as required.

2.8.4.3. Verify governing dimensions before fabricating items which abut wall surfaces.

2.8.4.4. Provide cutouts required and round internal corners, chamfer edges and seal exposed core.

2.8.4.5. Provide sidesplashes at abutting ends of counters and at adjoining walls, unless otherwise indicated.

2.8.4.6. Provide a 6 mm (1/4") drip groove approximately 13 mm (1/2") in from the underside edge.

2.8.4.7. Laminated Plastic Countertops:

2.8.4.7.1. Core material: Water resistant particle board.

2.8.4.7.2. Back splashes: height and profile as shown on drawings.

2.8.4.7.3. Front edges: As shown on plans.

2.8.4.8. Solid Surface Countertops:

2.8.4.8.1. Back splashes: height and profile as shown on drawings.

2.8.4.8.2. Front edges: As shown on plans.

2.8.5. Exposed wood construction:

2.8.5.1. Fabricate joints carefully matched for grain and colour.

2.8.5.2. Fabricate millwork with slow fed machines free from sticker and/or sander markings, with sections and moulding work cut accurately to profiles.

2.8.5.3. Sandpaper woodwork, smooth removing burrs, feathers, sleeves, raised grain and sharp arises and leave exposed surfaces perfectly clean and smooth ready for finishing.

2.8.5.4. Provide edges noted to be solid, as minimum 6 mm (1/4") thick wood to match exposed veneer, glued to core prior to the application of face veneers.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

3.2.1. Install work of this Section in accordance with appropriate Section of NAAWS.

3.2.2. Provide work of this Section true and straight and securely fastened in place.

3.2.3. Mitre exposed corners.

3.2.4. Provide plastic laminate countertops plumb and true, neatly scribed to adjoining surfaces.

3.2.5. Thoroughly fix and anchor work of this Section into position.

3.2.6. Mechanical and Electrical Fittings:

3.2.6.1. Provide openings required to accommodate mechanical and electrical fittings as part of the work of this Section and provide a core sealant to protect counter cores which are exposed to accommodate:

3.2.6.1.1. Mechanical services and fittings.

3.2.6.1.2. Washroom accessories.

3.2.6.2. Mechanical and electrical fittings and services will be provided as part of the work of Mechanical and Electrical

3.2.7. Installation of Hardware:

3.2.7.1. Install architectural woodwork hardware in accordance with manufacturer's requirements and templates. Adjust architectural woodwork hardware to provide smooth operation and ensure clearances are maintained. Repair damage to adjacent surfaces resulting from failure to conform with this requirement.

3.2.7.2. Provide lubricants required and use in manner to ensure smooth function of hardware consistent with manufacturer's recommendations.

3.2.7.3. Verify fastening components are tightened securely. Align screws, bolts and similar fastenings such that relationship of screw head indentations, similar surfaces and slots are perpendicular to matching vertical or horizontal position when on same surface. Do not burr or otherwise mar edges of surfaces of hardware components. Repair defects caused by work of this Section in an acceptable manner.

3.3. ADJUSTING & TOUCH UP

3.3.1. Adjust all moving and operating parts to function smoothly and correctly.

3.3.2. Fill and retouch all nicks, chips and scratches. Replace all un-repairable damaged items.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes:

1.1.1.1. Provide firestopping and smoke seals at penetrations and at joints in fire rated assemblies.

1.1.1.2. Make repairs to existing fire rated assemblies as necessary.

1.2. ADMINISTRATIVE REQUIREMENTS

1.2.1. Coordination:

1.2.1.1. Coordinate construction of openings and penetrating items to ensure that through-penetration fire-stop systems are installed according to specified requirements.

1.2.1.2. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire-stop systems.

1.2.1.3. Do not cover up through-penetration fire-stop system installations that will become concealed behind other construction until manufacturer's representative and building inspector, if required by Authorities Having Jurisdiction, have examined each installation.

1.2.2. Preinstallation Meetings:

1.2.2.1. Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor include Consultant who may attend, Subcontractor performing work of this trade, Owner’s representative, testing company's representative and consultants of applicable discipline.

1.3. SUBMITTALS

1.3.1. Product Data:

1.3.1.1. Submit manufacturers’ specifications and technical data for each material including compositions, limitations, documentation conforming ULC and/or cUL firestop system proposed for this Project and manufacturers’ installation instructions.

1.4. QUALITY ASSURANCE

1.4.1. Ensure firestopping systems conform to requirements of CAN/ULC-S115 tested assemblies that provide fire rating as shown.

1.5. SITE CONDITIONS

1.5.1. Ambient Conditions:

1.5.1.1. Comply with manufacturer's recommended requirements for temperature, relative humidity, moisture content and presence of any sealer or release agents on substrate during application and curing of materials. Ensure surfaces are dry and frost free.

1.5.1.2. Maintain minimum temperature of 5 deg C (40 deg F) for minimum period of 1 week before application, during application and until application is fully cured.

1.5.1.3. Ventilate areas in which firestopping is being applied. Protect water-soluble material from wetting until fully cured.

PART 2 - PRODUCTS

2.1. FIRE RESISTIVE JOINT PRODUCTS

2.1.1. For pipe penetrations in vertical assemblies, horizontal assemblies and smoke barrier:

2.1.1.1. 3M Fire Barrier Sealant FD 150+: Single-part, acrylic latex sealant. No-sag, low-shrinkage, low VOC.

2.1.1.2. Fire Resistance: For use in 1, 2, 3 or 4-hour fire-rated systems.

2.1.1.3. Compression/Extension Recovery: Up to +/- 19 percent of original joint width.

2.1.1.4. Meets optional L rating requirements.

2.1.1.5. STC rating of 56 when tested in STC 56-rated wall assembly.

2.1.2. For filling voids in concrete gypsum, metal, plastic, wood and insulation:

2.1.2.1. 3M Fire Barrier Water Tight Sealant 3000 WT: intumescent silicone firestop sealant.

2.1.2.2. Fire Resistance: For use in 1, 2 or 3 hour fire rated systems.

2.1.2.3. Meets UL Water Leakage Test, W Rating – Class 1 requirements.

2.1.2.4. STC-Rating of 53 when tested in STC-53-rated wall assembly.

2.1.3. For horizontal floor openings:

2.1.3.1. 3M Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling elastomeric silicone sealant. Sag-resistant, low VOC.

2.1.3.2. Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.

2.1.3.3. Meets UL Water Leakage Test, W Rating – Class 1 requirements.

2.1.3.4. Compression/Extension Recovery: Up to +/- 15 percent of original joint width.

2.1.3.5. STC-Rating of 56 when tested in STC-56-rated wall assembly.

2.1.4. For mechanical, electrical and plumbing pipe, conduit, communication cabling, and telephone wiring in vertical and horizontal assemblies:

2.1.4.1. 3M Fire Barrier Sealant 2000 NS: Silicone Sealant: Single-part, elastomeric silicone sealant. Sag-resistant, low VOC.

2.1.4.2. Fire Resistance: For use in 1, 2, 3 or 4-hour fire rated systems.

2.1.4.3. Compression/Extension Recovery: Up to +/- 13 percent of original joint width.

2.1.5. For pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products in vertical assemblies, horizontal assemblies and smoke barrier:

2.1.5.1. 3M Fire Barrier Moldable Putty+: one-part, 100 percent solids intumescent firestop

2.1.5.2. Fire Resistance: For use in 1, 2, or 3-hour fire rated systems

2.1.5.3. For sealing large or complex openings such as cable bundles, cable trays and conduit banks:

2.1.5.4. 3M Fire Barrier 2001 Silicone RTV Foam, Two-part, liquid-silicone elastomer foam

2.1.5.5. Fire Resistance: For use in 1, 2, or 3-hour fire rated systems

2.1.6. For use at head-of-wall, wall-to-wall, floor-to-floor, bottom-of-wall, floor-to-wall and perimeter joints:

2.1.6.1. 3M FireDam Spray 200, Water-based, paintable, low VOC, freeze/thaw resistant spray applied fire resistive product. Applied with conventional airless spray equipment:

2.1.6.2. Fire Resistance: For use in 1, 2, 3 or 4-hour fire rated systems.

2.1.6.3. Compression/Extension Recovery: Up to +/- 50 percent of joint width.

2.1.6.4. STC-Rating of 56 when tested in STC 56-rated wall assembly.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions:

3.1.1.1. Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.1.1.2. Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.

3.1.1.3. Examine sizes of penetrating service, percentage fill and sleeve or opening sizes with exact annular space calculations, anticipated movement and conditions necessary to establish correct type, thickness and installation of back-up materials and seals.

3.1.1.4. Since firestop systems do not re-establish structural integrity of load bearing partitions/ assemblies, or support live loads and traffic, consult structural engineer prior to penetrating any load bearing assembly.

3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

3.2.1. Surface Preparation:

3.2.1.1. Provide primer or surface conditioner if required by Product manufacturer. Prime surfaces in accordance with manufacturer's directions.

3.2.1.2. Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.

3.2.1.3. Remove insulation from insulated pipe and duct where such pipes or ducts penetrate a fire separation unless ULC certified assembly permits such insulation to remain within assembly, or where mechanical trades have installed special fire rated insulated sleeves. Ensure continuity of thermal and vapour barriers where such are removed, altered or replaced, to satisfaction of Mechanical and Electrical and Consultant.

3.2.1.4. Alternatively, ensure pipe and duct insulation and wrappings occurring within openings to receive firestopping and smoke seals under this Section are installed prior to work of this Section and insulation and wrappings within fire seals are ULC listed components of system to be installed under this Section, unless ULC certified assembly permits such other insulation and wrappings to remain within assembly. Coordinate work of this Section with Mechanical and Electrical.

3.2.1.5. Clean bonding surfaces to remove deleterious substances including dust, paint, rust, oil, grease, moisture, frost and other foreign matter which may otherwise impair effective bonding.

3.3. INSTALLATION

3.3.1. Install in strict accordance with manufacturer's detailed installation instructions and procedures.

3.3.2. Install so that openings are completely filled and material is securely adhered.

3.3.3. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.

3.3.4. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.

3.3.5. Repair or replace defective installations in accordance with manufacturer's recommendations, listed systems details and applicable code requirements.

3.3.6. At each through penetration or fire-resistive joint system, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.

3.3.7. 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.

3.3.8. 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.

3.3.9. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Provide joints sealants including but not limited to following:

1.1.1.1. Exterior control joints between new brick masonry and existing

1.1.1.2. Interior control joints, joints in tiling, joints between millwork and walls, joints around door frames, and where shown in the drawings.

1.1.1.3. Acoustical joint seants.

1.2. ADMINISTRATIVE REQUIREMENTS

1.2.1. Coordination:

1.2.1.1. Coordinate installation of joint sealants with sequence of work by other Sections.

1.2.2. Preinstallation Meeting:

1.2.2.1. Prior to start of work, arrange for Project site meeting of parties associated with work of this Section. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Contractor's consultants of applicable discipline and Owner's representative.

1.2.2.2. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of this Section. Discuss also following items:

1.2.2.2.1. Verify with sealant manufacturer that specified sealants are compatible with and will satisfactorily adhere to substrates.

1.2.2.2.2. Weather conditions under which work will be done.

1.2.2.2.3. Anticipated frequency and extent of joint movement.

1.2.2.2.4. Joint design.

1.2.2.2.5. Suitability of durometer hardness and other properties of material to be used.

1.2.2.2.6. Recommendations of manufacturer for mixing of multi-component sealants.

1.2.2.2.7. Number of beads to be used in sealing operation and priming operation if required.

1.3. ACTION SUBMITTALS

1.3.1. Product Data:

1.3.1.1. Submit Product information from sealant manufacturer prior to commencement of work of this Section including:

1.3.1.1.1. Preparation instructions and recommendations.

1.3.1.1.2. Standard drawings illustrating manufacturer's recommended sealant joint profiles and dimensions applicable to Project.

1.3.1.1.3. Composition and physical characteristics.

1.3.1.1.4. Surface preparation requirements.

1.3.1.1.5. Priming and application procedures.

1.3.1.1.6. Suitability of sealants for purposes intended and joint design.

1.3.1.2. Joint sealant schedule: indicating application, joint location, sealant type, manufacturer and product name, and colour, for each application. Utilize joint sealant designations included in this Section.

1.4. QUALITY ASSURANCE

1.4.1 Installers: Provide work of this Section executed by competent installers and have minimum of 5 years experience in application of Products, systems and assemblies specified and with approval and training of sealant manufacturer.

1.5. DELIVERY, STORAGE AND HANDLING

1.5.1. Delivery and Acceptance Requirements: Deliver caulking and sealant materials to site in original, unopened containers with manufacturers' labels and seals intact. Labels to identify manufacturer's name, brand name of Product, grade and type, application directions and shelf life or expiry date of Product.

1.6. PROJECT CONDITIONS

1.6.1. Ambient Conditions:

1.6.1.1. Do not apply any sealant under adverse weather conditions, when joints to be sealed are damp, wet or frozen or when at ambient temperatures below 5 deg C (40 deg F). Maintain minimum temperature of application during application and for 8 hours after application. Consult manufacturer for specific instructions before proceeding and obtain Consultant's approval.

1.6.1.2. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated and until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6.2. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

1.6.3. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1. PERFORMANCE/DESIGN CRITERIA

2.1.1. Compatibility:

2.1.1.1. Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.1.2. Provide Products with capability, when tested for adhesion and cohesion under maximum cyclic movement in accordance with ASTM C719, to withstand required percentage change in joint width existing at time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.

2.2. JOINT SEALANTS

2.2.1. Exterior control joints in unit masonry: Nonsag, Neutral-Curing Silicone Joint Sealant:

2.2.1.1. Hardness, ASTM C661: 15 durometer Shore A.

2.2.1.2. Volatile Organic Compound (VOC) Content: 26 g/L maximum.

2.2.1.3. Staining, ASTM C1248: None on concrete, granite, limestone, and brick.

2.2.1.4. Color: As selected by Consultant.

2.2.1.1. Basis of Design Product: “DOWSIL 790 Silicone Building Sealant” by Dow.

2.2.1.2. Acceptable Alternatives:

2.2.1.2.1. “Spectrem 1” by Tremco

2.2.1.2.2. “SCS2700 SilPruf LM” by Momentive Performance Materials

2.2.1.2.3. “890NST” by Pecora

2.2.1.2.4. “290 DC PRO” by Sika Canada

2.2.2. Interior control joints in masonry and gypsum board: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant.

2.2.2.1. Hardness, ASTM C661: 15 durometer Shore A.

2.2.2.2. Volatile Organic Compound (VOC) Content: 22 g/L maximum

2.2.2.3. Staining, ASTM C510: None.

2.2.2.4. Color: As selected by Consultant.

2.2.2.5. Basis of Design Product: “DOWSIL CCS” by Dow.

2.2.2.6. Acceptable Alternatives:

2.2.2.6.1. “Dymonic FC”, by Tremco

2.2.2.6.2. “Sikaflex 1a” by Sika

2.2.3. Interior joints in ceramic tile, at sinks, urinals, and casework: Mildew-Resistant, Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant:

2.2.3.1. Basis of Design Product: “DOWSIL 786 Silicone Sealant” by Dow.

2.2.3.2. Hardness, ASTM D2240: 25 durometer Shore A

2.2.3.3. Volatile Organic Compound (VOC) Content: 36 g/L maximum.

2.2.3.4. Color: As selected by Consultant.

2.2.3.5. Basis of Design Product: “DOWSIL 786 Silicone Sealant” by Dow.

2.2.3.6. Acceptable Alternatives:

2.2.3.6.1. “Tremsil 200” by Tremco

2.2.3.6.2. “SCS1700 Sanitary” by Momentive Performance Materials

2.2.3.6.3. “KB 4800” by Adfast“

2.2.4. Interior non-moving paintable joints: Acrylic Latex or Siliconized Acrylic Latex Products: Single-Component, comply with ASTM C834.

2.2.4.1. Products: provide products by one of the following:

2.2.4.1.1. “Chem-Calk 600”; by Bostik Inc.

2.2.4.1.2. “AC-20+”; by Pecora Corporation

2.2.4.1.3. “Sonolac”; BASF Building Systems

2.2.4.1.4. “Tremflex 834”; by Tremco Incorporated.

2.2.4.1.5. “Bondaflex 600”; by May National Associates, Inc.

2.2.4.1.6. “EcoTex 25”; by Everkem Diversified Products, Inc.

2.2.4.1.7. "Titebond GREENchoice Acoustical Smoke and Sound Sealant"; by Franklin International, Inc.

2.2.4.1.8. "White Lightning Bolt Quick Dry Siliconized Acrylic Latex Sealant"; by Sherwin-Williams Company.

2.2.4.2. Colour: as selected by Consultant.

2.2.5. Interior concealed joints in acoustic assemblies: Acoustical Joint Sealant Standard: Manufacturer's standard non-sag, paintable, non-staining latex sealant:

2.2.5.1. Volatile Organic Compound (VOC) Content: 31 g/L maximum

2.2.5.2. Products: provide products by one of the following:

2.2.5.2.1. "AC-20 FTR" or "AIS-919"; by Pecora Corporation.

2.2.5.2.2. "SHEETROCK Acoustical Sealant"; by USG Corporation.

2.3. JOINT-SEALANT BACKING

2.3.1. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2.3.2. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance. Provide any Type schedule below, as approved in writing by joint-sealant manufacturer for joint application indicated.

2.4. MISCELLANEOUS MATERIALS

2.4.1. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

2.4.2. Bond Breaker Tape: As recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4.3. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

2.4.4. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints. Leave no residue.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions:

3.1.1.1. Examine joints for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Ensure joints are suitable to accept and receive sealants.

3.1.1.2. Examine joint sizes and where depth of joint exceed required depth of sealant correct to achieve proper following width/depth ratio:

3.1.1.2.1. Maintain 2:1 Width/Depth Ratio: Ensure maximum sealant depth is 13 mm (1/2") and minimum contact width with each substrate is 6 mm (1/4"). Confirm width/depth ratios with sealant manufacturers.

3.1.1.3. Verify joint surfaces are clean, sound, free of defects and dimensions are within sealant manufacturer's size requirements.

3.1.1.4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1.1.5. Do not apply sealant to masonry until mortar has cured.

3.1.2. Preinstallation Testing: Before any sealing work is commenced, test materials for indications of staining or poor adhesion.

3.1.3. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

3.2.1. Protection of In-Place Conditions: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2.2. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

3.2.2.1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

3.2.2.2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3.2.3. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3. INSTALLATION OF JOINT SEALANTS

3.3.1. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

3.3.2. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

3.3.3. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

3.3.3.1. Do not leave gaps between ends of sealant backings.

3.3.3.2. Do not stretch, twist, puncture, or tear sealant backings.

3.3.3.3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

3.3.4. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

3.3.5. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

3.3.5.1. Place sealants so they directly contact and fully wet joint substrates.

3.3.5.2. Completely fill recesses provided for each joint configuration.

3.3.5.3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

3.3.6. Force sealant into joint and against sides of joints to obtain uniform adhesion. Use sufficient pressure to completely fill voids in joint regardless of variation in joint widths and to proper joint depth as prepared. Ensure full firm contact with interfaces of joint. Superficial pointing with skin bead is not acceptable.

3.3.7. Finish face of compound to form smooth, uniform beads. At recesses in angular surfaces, finish compound with flat face, flush with face of materials at each side. At recesses in flush surfaces, finish compound with concave face flush with face of materials at each side.

3.3.8. Compound may be tooled, provided such tooling does not damage seal or tear compound. Avoid pulling of sealant from sides.

3.3.9. Tool surfaces as soon as possible after sealant application or before any skin formation has occurred, particularly when using silicone sealants.

3.3.10. Ensure joint surfaces are straight, neatly finished, free from ridges, wrinkles, sags, dirt, stains, air pockets and embedded foreign matter or other defacement and be uniform in colour, free from marbling and/or colour streaking due to improper mixing or use of out of shelf life Products.

3.3.11. Tooling of Non sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

3.3.11.1. Remove excess sealants from surfaces adjacent to joint.

3.3.11.2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3.3.11.3. Provide concave joint configuration per Figure 8A in ASTM C1193, unless otherwise indicated.

3.4. CLEANING

3.4.1. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Work requirements for flooring restoration including but not limited to following:

1.1.1.1. Refurbish and repair existing terrazzo flooring where indicated in the drawings

1.2. REFERENCES

1.2.1. Terrazzo, Tile and Marble Association of Canada: Specification Guide, Tile Installation Manual

1.3. ADMINISTRATIVE REQUIREMENTS

1.3.1. Pre-Installation Meetings:

1.3.1.1. Prior to commencement of work, arrange for Project site meeting of all parties associated with work of this Section in accordance with project meetings specified in Section 01 10 00.

1.3.1.2. Include manufacturer’s technical representative, Contractor, Installers performing work of this Section, subcontractors installing finishes over these products (if applicable).

1.3.1.3. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of placement and other matters affecting construction.

1.4. SUBMITTALS

1.4.1. Submittals in accordance with Submittal Procedures specified in Section 01 10 00.

1.4.2. Product Data:

1.4.2.1. Submit manufacturer's Product data, performance criteria, application instructions, and other documentation for each material specified in this Section proposed for use.

1.4.2.2. Include product characteristics, performance criteria, finish and limitations.

1.4.2.3. Safety: Provide WHMIS Material Safety Data Sheets.

1.5. QUALITY ASSURANCE

1.5.1. Execute work of this Section by professionals who are specialized in the use of specific equipment and materials, trained in terrazzo finishing, and have minimum 5 years experience in this work.

1.5.2. Applicator to be a member of the Terrazzo, Tile and Marble Association of Canada (TTMAC). Submit evidence of this if requested.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Deliver materials in manufacturer's packaging including application instructions.

1.7. SITE CONDITIONS

1.7.1. Ventilation: Provide continuous ventilation during and after coating application.

PART 2 - PRODUCTS

2.1. MATERIALS

2.1.1. Terrazzo refurbishing materials:

2.1.1.1. Stripper: propose environmentally friendly cleaner.

2.1.1.2. Grout: General Polymers 5271 Terrazzo Grout Filler.

2.1.1.3. Sealer: General Polymers 4401 Terrazzo Sealer.

2.1.1.4. Water: clean and potable.

PART 3 - EXECUTION

3.1. PREPARATION

3.1.1.1. Thoroughly clean surfaces by scrubbing to remove dirt, dust, and wax. Use stripper in accordance with manufacturer's printed instructions.

3.1.1.2. Remove dirty solution with wet vacuum or mop.

3.1.1.3. Rinse with clean water and allow to dry thoroughly.

3.2. REFURBISH EXISTING TERRAZZO

3.2.1. Grind existing terrazzo floor and base with No. 80 grit abrasive stones using floor machine and base grinding machine for base. Keep area wet with water at all times. Wash surfaces with clean water.

3.2.2. Remove excess rinse water and apply grout to fill pinholes, cracks and voids. Allow grout to remain on surface and cure for minimum 24 hours before final grinding.

3.2.3. Grind existing terrazzo floor and base with No. 120 grit carborundum using floor machine and base grinding machine for base. Keep area wet with water at all times. Wash surfaces with a neutral cleaner. Rinse with clean water and allow to dry thoroughly.

3.2.4. Apply 2 coats sealer.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes:

1.1.1.1. Testing and preparation of substrate for installation of flooring.

1.1.1.2. Moisture vapour control topping.

1.1.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.1.2.1. Filling of major holes, crack repairs, patching chases and trenches in concrete substrate Flatness and levelness requirements for floor to receive resilient sheet flooring: Section 03 01 30 – Repairs to Concrete.

1.1.2.2. Ceramic and porcelain tile: Section 09 30 00 - Tiling

1.1.2.3. Vinyl flooring: Section 09 65 19 – Resilient Tile Flooring

1.2. ADMINISTRATIVE REQUIREMENTS

1.2.1. Coordination:

1.2.1.1. Coordinate preparation of concrete flooring with installation of flooring materials. Ensure that proposed materials are compatible and will achieve correct results.

1.2.1.2. Determine acceptable limits for moisture vapour emissions, and pH with each of the finish flooring manufacturers.

1.2.1.3. Schedule surface preparation work with the concrete trade and flooring installation trade.

1.2.2. Preinstallation Meeting:

1.2.2.1. Prior to start of concrete work, arrange for Project site meeting of all parties associated with work of this Section, including Contractor, various flooring installers, and concrete finisher in accordance with Section 01 10 00.

1.2.2.2. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions flooring installation and other matters affecting construction, to permit compliance with intent of this Section. Ensure Division 03 requirements for concrete are compatible with requirements of this Section; floor flatness and floor levelness requirements for various floor finishes and their acceptability by flooring manufacturer; surface texture of finished floor required for various floor finishes; acceptable approaches to remediation of high moisture and high pH floors; adhesive application and floor covering installation.

1.3. SUBMITTALS

1.3.1. Product Data Sheets:

1.3.1.1. Submit product data sheets for all products proposed for use in this Section.

1.3.1.2. Submit WHMIS Safety Data Sheets for each product.

1.3.2. Shop Drawing: submit floor plan showing the locations of all field testing of concrete floors.

1.3.3. Test and Evaluation Reports:, submit field test reports from recognized approved independent testing laboratory for following requirements:

1.3.3.1. Submit letters of acceptance from each manufacturer of flooring products specified in related Sections that the combination of products and methods used in the overall flooring preparation and installation are compatible and appropriate for their intended application.

1.3.3.2. Submit moisture vapour emissions testing for all concrete floor areas.

1.3.3.3. Submit calcium chloride test results in accordance with requirements specified herein.

1.3.3.4. Submit pH test results and verify their acceptability to resilient sheet flooring manufacturer in accordance with requirements specified herein.

1.4. CLOSEOUT SUBMITTALS

1.4.1. Update floor plan shop drawing with notes to confirm field testing locations and final test readings.

1.5. QUALITY ASSURANCE

1.5.1. Qualifications:

1.5.1.1. Field Testing Inspectors: Independent 3rd party inspectors with minimum three years experience with concrete testing.

1.5.1.2. Installers: Provide work of this Section executed by competent installers with minimum of 5 years experience in concrete preparation and application of concrete Products specified.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Delivery and Acceptance Requirements:

1.6.1.1. Deliver materials in good condition to site in manufacturer's original unopened containers that bears name and brand of manufacturer, Project identification, shipping and handling instructions.

1.7. SITE CONDITIONS

1.7.1. Ambient Conditions:

1.7.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions. Follow Product MSDS and label instructions concerning safety, health and other related precautionary and environmental protection.

1.7.1.2. Maintain relative humidity in accordance with manufacturer's instructions.

1.7.1.3. Exhaust temporary heaters to building exterior to prevent health hazards and damage to work from toxic fumes and emanations.

1.7.1.4. Maintain ambient air temperature and temperature of floor covering areas at not less than 10 deg C (50 deg F) or more than 29 deg C (85 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

1.8. WARRANTY

1.8.1. Manufacturer Warranty: Warrant work of this Section for period of 25 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, at no expense to Owner.

1.8.2. Defects include but are not limited to; failure of floor finish remaining in place and bonding to structural slab and finish becoming defective and spalling and/or cracking.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

2.1.1.1. Ardex Canada, Inc.; www.ardex.ca

2.1.1.2. Flextile Ltd.; www.flextile.net

2.1.1.3. Laticrete International, Inc.; www.laticrete.com

2.1.1.4. Mapei Corporation; www.mapei.ca

2.2. MATERIALS

2.2.1. Concrete Moisture Emission Reducer: Characteristics, performance requirements:

2.2.1.1. Epoxy cement, compliant with ASTM F3010.

2.2.1.2. Antimicrobial additive

2.2.1.3. Reduce the moisture vapour emission rate of concrete slabs ≤ 3 lbs. per 1,000 ft^2 per 24 hours.

2.2.1.4. Reduce the surface alkalinity of concrete slabs down to pH levels of 9

2.2.1.5. Provide 1 of following:

2.2.1.5.1. “Planiseal™ VS” by Mapei Corporation.

2.2.1.5.2. “Sikafloor® 81 EpoCemCA” by Sika Canada Inc.

2.2.1.5.3. “Ardex MC Rapid” by Ardex Canada

2.2.2. Primer:

2.2.2.1. Provide 1 of following:

2.2.2.1.1. “4040 Acrylic Primer” by Flextile Ltd except where epoxy moisture mitigation systems.

2.2.2.1.2. “Primer X” by Mapei Corporation

2.2.2.1.3. “Sikafloor 155 WN” by Sika Canada

2.2.2.1.4. “Ardex P4” by Ardex Canada

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions for New Concrete:

3.1.1.1. Ensure new concrete slab has been properly cured and dry for minimum of 28 Days and has reached minimum compressive strength of 25 MPa (3625 psi) and a minimum of 1.5 MPa (218 psi) in tension.

3.1.1.2. Ensure no curing and sealing compounds, hardeners or other chemical additives have been used on concrete.

3.1.1.3. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.2. TESTING FOR ALL CONCRETE FLOORS:

3.2.1. Conduct concrete testing on all concrete floors prior to application of moisture vapour control topping and following corrective work.

3.2.2. Moisture Vapour Testing:

3.2.2.1. Perform calcium chloride test no earlier than 28 Days after concrete has been placed in accordance with requirements of ASTM F1869 for new and existing concrete floors, and in-situ probe RH testing in accordance with ASTM F2170 for new concrete prior to installation of flooring material.

3.2.2.2. Conduct 3 tests for each of the RH test methods for first 93 m2 (1000 sq ft) and 1 additional test for every 93 m² (1000 sq ft) of flooring. Ensure moisture emission from concrete floor does not exceed 2.27 kg/93 m² (5 lbs/1000 sq ft) in 24 hours or has a maximum RH of 80%.

3.2.2.3. Provide results to Consultant prior to commencement of installation including diagram of area tested showing location of each moisture test.

3.2.2.4. When concrete moisture emission rate is between 2.27 kg/93 m² (5 lbs/1000 sq ft) and 6.79 kg/93 m² (15 lbs/1000 sq ft) and in 24 hours use a concrete moisture emission reducer.

3.2.2.5. Do not proceed with installation until moisture problem has been corrected.

3.2.3. Alkalinity Testing (pH):

3.2.3.1. Measure pH of concrete in accordance with ACI PRC-364.17: How to Measure pH of a Concrete Surface Prior to Installation of a Floor Covering.

3.2.3.2. Perform pH test no earlier than 28 Days after concrete has been placed to ensure alkali salt residue is within limitation acceptable to manufacturer and to avoid adhesive failure, discoloration, shrinkage and softening of floor covering. If pH results are higher than 9.0, report to Consultant, Contractor or Owner for investigation and remedial work.

3.2.3.3. Perform at least three pH tests must be performed for the first 93 m² (1,000 square feet) of space. One additional test should be performed for each additional 93 m² (1,000 square feet 0 thereafter.

3.2.3.4. Refer to manufacturer for ways to neutralize floor prior to beginning of installation. Neutralize by sanding, vacuuming and/or by water plus mild sulfuric or sulfamic acid application as recommended by manufacturer.

3.2.3.5. Retest to assure pH has been neutralized.

3.2.4. Capillary Moisture Testing:

3.2.4.1. Moisture content of concrete substrate must be ≤ 4 % by mass (PBW – part by weight) as measured with a Tramex®CME / CMExpert type concrete moisture meter.

3.2.4.2. Before proceeding with application, test surfaces for moisture content in accordance with ASTM D4263 and in consultation with manufacturer to ensure they are suitable for application.

3.2.4.3. Provide all test results to Consultant prior to commencement of installation including diagram of area tested showing location of each moisture test, alkalinity test and capillary moisture test.

3.2.5. Evaluation and Assessment:

3.2.5.1. Report all testing results to manufacturer's representative and submit written acceptance of these results approval before proceeding.

3.2.5.2. Commencement of work implies acceptance of previously completed work.

3.3. SURFACE PREPARATION

3.3.1. For all new and existing concrete floor areas:

3.3.1.1. Prepare existing and new concrete floors over entire area with steel shot blasting or other method recommended by manufacturer. Remove uneven joints, rough areas, foreign and

projection off surfaces. Surface to be hard, sound and roughened to irregular surface with weak concrete removed and surface holes and voids exposed. Equip dry blasting machine with vacuum to minimize dust.

3.3.1.2. Shot blast floor to remove soft material and to achieve a profile equivalent to ICRI / CSP 3 – 4.

3.3.1.3. Shot blast to expose cracks in concrete surface. For cracks lesser than 1.5 mm (1/16") employ crack reinforcing tape in accordance manufacturer's recommendations. Repair cracks, holes or other deficiencies in accordance with manufacturer's recommendations.

3.3.1.4. Blow clean control joints, sawcuts and cracks with compressed air.

3.3.1.5. Prepare concrete floors to receive sheet flooring in accordance with requirements of ASTM F710. Achieve CSP of #2 - #3. Consult individual manufacturer for their specific recommendations and follow them as required.

3.4. MOISTURE BARRIER APPLICATION

3.4.1. If moisture levels exceed acceptable limit, apply moisture emission reducer in accordance with ASTM F710 and ASTM F3010.

3.4.2. Follow manufacturer's recommendations to determine whether cracks are filled before or after application of moisture barrier cement.

3.4.3. Mix moisture barrier in accordance with manufacturer's printed instructions.

3.4.4. Material components minimum 15°C (60°F) at time of mixing.

3.4.5. Apply coating using roller to achieve thickness as per manufacturer's instructions. Allow to cure.

3.4.6. Apply second coat of moisture barrier coating, dry film thickness of 12.8 mils. Allow to cure.

3.4.7. Re-test for moisture vapour emission and pH level.

3.5. CLEANING

3.5.1. Remove excess adhesive from floor, base and wall surfaces without damage.

3.5.2. Clean floor and base surface to flooring manufacturer's instructions.

3.6. PROTECTION

3.6.1. Protect installed flooring as recommended by flooring manufacturer against damage from rolling loads, other trades or placement of fixtures and equipment.

3.6.2. Prohibit foot traffic on floor for 24 hours after installation. Prohibit heavy traffic, rolling loads and furniture or appliance placement for a minimum of 72 hours after installation.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Provide acoustical panel ceilings including but not limited to following:

1.1.1.1. Ceiling suspension systems.

1.1.1.2. Lay-in acoustical ceiling panels.

1.1.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.1.2.1. Provision of suspended support framing: - Section 09 22 16 Non-Structural Metal Framing.

1.1.2.2. Provision of mechanical fixtures: refer to mechanical.

1.1.2.3. Provision of electrical, communication and security fixtures: refer to electrical.

1.2. ADMINISTRATIVE REQUIREMENTS

1.2.1. Coordination:

1.2.1.1. Do not begin installation of ceiling suspension system until work above ceiling has been completed and inspected.

1.2.1.2. Coordinate ceiling work to accommodate components of other Sections built into acoustical ceilings.

1.2.2. Preinstallation Meetings:

1.2.2.1. Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor include Consultant who may attend, Subcontractor performing work of this trade, Owner’s representative.

1.2.2.2. Purpose of meeting:

1.2.2.2.1. Verify Project requirements,

1.2.2.2.2. Discuss coordination with work of other Sections,

1.2.2.2.3. Review manufacturer's installation instructions [and warranty conditions],

1.2.2.2.4. Discuss and coordinate exact locations of ceiling-mounted components,

1.2.2.2.5. Discuss accepted shop drawings for special installation details, and

1.2.2.2.6. Review existing substrate conditions.

1.2.3. **ACTION AND INFORMATIONAL SUBMITTALS**

1.2.4. Product Data: Submit Product data on ceiling grid system, acoustical panels; clearly indicate specific items proposed for use if manufacturer's catalogues are submitted.

1.2.5. Shop Drawings: Submit Shop Drawings for work of this Section. In addition to minimum requirements indicate following:

1.2.5.1. Reflected plans of ceilings, joint pattern, position of suspension grids, seismic requirements, methods of suspension and termination at walls, partitions, bulkheads, lighting fixtures and mechanical fixtures.

1.2.5.2. Indicate insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, change in level details, access door dimensions and locations, lateral bracing and accessories.

1.2.5.3. Submit reflected ceiling plans detailed in measurement system (e.g. imperial or metric) to match Drawings.

1.2.5.4. Ensure a licensed engineer specified herein is responsible for:

1.2.5.4.1. Production and review of Shop Drawings.

1.2.5.4.2. Sealing and signing each Shop Drawing and any associated calculations performed.

1.2.6. Samples: Submit following samples in sizes indicated:

1.2.6.1. Submit 300 mm (12") long samples of suspension system parts, including trim and seismic items.

1.2.6.2. Submit 300 mm x 300 mm (12" x 12") samples of acoustical panels.

1.2.7. Delegated Design Submittals:

1.2.7.1. Submit delegated design shop drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

1.2.7.2. Indicate that components and installation methods conform to specified seismic design and construction requirements of Contract Documents and in accordance with ASTM E580/E580M.

1.2.7.3. Include supporting details, treatment of cross runners, main runners, and wall closures at terminal ends, suspension wire, lateral force bracing, light fixtures, services within the ceiling, seismic isolation joints, and partition bracing.

1.3. CLOSEOUT SUBMITTALS

1.3.1. Operational and Maintenance Data: Submit maintenance instructions to Owner for recommended cleaning materials and methods for panels and trim. Include precautions for use of and composition of cleaning materials detrimental to acoustic materials and trim.

1.4. QUALITY ASSURANCE

1.4.1. Qualifications:

1.4.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.4.1.2. Licensed Professionals: Employ a licensed engineer carrying minimum $2,000,000.00 professional liability insurance and is registered in the Province of Ontario.

1.4.2. Mock-Ups:

1.4.2.1. Construct mock-up a minimum 10 m ² of each type of acoustical ceiling assembly including one inside corner and one outside corner. Ceiling system mock-up to show basic construction and assembly, treatment at walls, splicing, interlocking, finishes, acoustical unit installation, seismic reinforcing, one recessed light fixture, and one sprinkler head.

1.4.2.2. Construct mock-up at Project site where directed by Consultant.

1.4.2.3. Allow minimum 48 hours for review of the mock-up.

1.4.2.4. Mock-up may remain as part of the finished work and serve as standard of workmanship for the balance of the work.

1.5. DELIVERY, STORAGE AND HANDLING

1.5.1. Delivery and Acceptance Requirements: Deliver materials in original packages, containers and bundles, bearing brand and manufacturer's name and ULC or cUL labels.

1.5.2. Storage and Handling Requirements:

1.5.2.1. Store materials in a covered area, off ground, on flat, smooth, dry surfaces. Protect from moisture. Remove damaged or deteriorated materials from site.

1.5.2.2. Comply with ceiling panel manufacturer's recommendations regarding temperature and humidity conditions before, during and after ceiling installation.

1.6. WARRANTY

1.6.1. Manufacturer Warranty: Warrant work of this Section for period of 3 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

2.1.1.1. Armstrong World Industries Canada Ltd.; www.armstrongceilings.com

2.1.1.2. Bailey Metal Products Ltd.: www.bmp-group.com

2.1.1.3. CertainTeed Ceilings; www.certainteed.com

2.1.1.4. CGC Inc.; www.cgcinc.com

2.1.1.5. Rockfon; www.rockfon.com

2.1.2. Substitution Limitations: Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification.

2.2. MATERIALS

2.2.1. Description:

2.2.1.1. Regulatory Requirements: Ensure complete ceiling assemblies including panel and suspension system are fire rated and labelled in accordance with ULC Design number noted on Drawings.

2.2.2. Performance/Design Criteria:

2.2.2.1. Design suspension system to support safely and without distortion, superimposed loads of:

2.2.2.1.1. Lighting fixtures.

2.2.2.1.2. Air supply diffusers, boots, fire alarm grilles and exhaust and return air grilles.

2.2.2.1.3. Curtain tracks and window blinds.

2.2.2.1.4. Power grid system, where indicated.

2.2.2.1.5. Suspended equipment where indicated.

2.2.2.2. Design suspension system to support lighting fixtures according to Hydro One regulations and submit certification in accordance with ESA Rule 30-302 (1).

2.2.2.3. Design suspension system to accommodate movement caused by thermal expansion or contraction.

2.2.2.4. Design and space hangers and carrying members to support entire ceiling system, including lighting fixtures, diffusers and equipment openings in locations indicated on Drawings.

2.2.2.5. Maximum Deflection: Limit deflection to L/360 in accordance with ASTM C635/C635M deflection test.

2.2.2.6. Prepare panels for sprinkler head penetrations and suspension members of curtain tracks.

2.2.2.7. Coordinate installation and cooperate with Mechanical and Electrical Subcontractors, to accommodate mechanical and electrical items, or any other Work required to be incorporated in or coordinated with the ceiling system.

2.2.2.8. Structural Design: Employ a licensed engineer specified herein to:

2.2.2.8.1. Design components for work of this Section requiring structural performance.

2.2.2.8.2. Be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.

2.2.2.8.3. Seismic Restraints: Design system to withstand seismic forces in accordance with CSA S832 and as outlined in Ontario Building Code for post-disaster Importance Category facilities based on a full uniform ceiling load acceleration in accordance with ASTM A580/A580M. Ceiling areas less than 13.4 m ² and surrounded by walls connected to structure above do not require seismic restraints.

2.3. MATERIALS

2.3.1. Unless otherwise indicated, manufacture ceiling suspension Products to minimum requirements of ASTM C635/C635M, for Medium Duty, modified as required to suit grid design shown.

2.4. ACOUSTICAL CEILING SUSPENSION

2.4.1. Exposed Grid System:

2.4.1.1. Factory finished satin white on Z90 (G30) hot dipped galvanized cold rolled steel. Ensure system provides lock joint intersections of cross and main tees

2.4.1.2. 15/16” exposed face

2.4.1.3. Acceptable products:

2.4.1.3.1. "DONN DX/DXL® Suspension System" by CGC Inc.,

2.4.1.3.2. "Prelude® XL” Exposed Tee System" by Armstrong World Industries,

2.4.1.3.3. “Chicago Metallic 1200 Seismic” by Rockfon

2.4.1.3.4. “15/16” Classic Stab Systems” by CertainTeed Ceilings.

2.4.2. Basic Steel Material and Finish: Commercial quality cold rolled steel 0.455 mm (26 ga) minimum thickness, galvanized to zinc coating designation Z90 (G30) for normal interior spaces, Z180 (G60) for high humidity spaces and Z275 (G90) for exterior spaces. Ensure exposed surfaces of metal products are factory finished in non-yellowing, low sheen satin white enamel to Consultant’s acceptance to match whiteness in panels. Provide paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies. Provide slip-on trim mouldings or metal mouldings with baked enamel finish, as standard with grid manufacturer, to trim around light fixtures.

2.4.3. Accessories for Suspension System: Complete with splices, clips and perimeter moulding of manufacturer's standard and aluminum types to suit the applicable conditions unless special conditions and access areas are shown or specified. In washroom area provide galvanized suspension system.

2.4.4. Hanger Wire: Minimum 2.642 mm (12 ga) overall thickness galvanized steel wire to zinc coating designation Z275 (G90), meeting "Heavy-duty" classification of ASTM C635/C635M.

2.4.4.1. Access Panel Ceilings: Minimum 3.6 -mm diameter

2.4.4.2. Fire-Rated Assemblies: To ULC design requirements,

2.4.4.3. Seismic assemblies. To seismic Design Category

2.4.4.4. Other Ceilings: Minimum 2.642 mm (12 ga) diameter

2.4.5. Main Tees: 3.66 m (12') long, 23.8 mm (15/16") face width double web design, rectangular bulb at top of web, 38 mm (1-1/2") web height. Expansion cut-outs in main tees controlling buckling caused by heat expansion.

2.4.6. Main Tee Splices: Designed to lock lengths of main tees together so joined lengths of tee function structurally as single unit with tee faces at joint perfectly aligned and presenting tight seam.

2.4.7. Cross Tees: 1220 mm (4') long, 25 mm (1") web height structural cross-section, design same as main tees, designed to connect at main tees forming positive lock without play, loss or gain in grid dimensions with offset over-ride of face flange over main tee flange to provide flush joint. Provide 38 mm (1-1/2") web height of cross-tee for fire rated assemblies.

2.4.8. Edge Moulding Around Ceiling Perimeters: Materials and finish to match tees.

2.4.9. Panel Hold-Down Clips: As recommended by lay-in panel manufacturer. Purpose made clips to secure panel to suspension system approved for use in fire-rated systems, and to resist wind uplift near exterior doors.

2.4.10. Inserts for Concrete Slabs: Certified type for setting in concrete or self drilling expansion inserts for placing afterwards. Tie wire anchors:

2.4.10.1. Red Head TW-1614 by ITW Canada, Inc.,

2.4.10.2. Parabolt Wire Anchor by Acrow Richmond

2.4.10.3. T-14 Eyebolt by Ramset Ltd., or Tire Wire Drive TW-932 by Isometric Ltd.

2.4.11. Fasteners: Galvanized and of size suited to loading conditions.

2.4.12. Metal Closures and Trim: Bonderized and with factory-applied white baked enamel finish. Provide anchors as standard with manufacturer.

2.4.13. Supplementary Steel Supports: Steel conforming to Section 05 50 00 - Metal Fabrications.

2.5. ACOUSTICAL CEILING PANELS

2.5.1. Acoustical Lay-in Panels: CAN/CGSB-92.1-M, acoustical units, prefabricated, with white painted textured and/or smooth face, qualified for use in fire rated ceiling assembly; ULC or cUL labelled and meeting following performance criteria as determined by CAN/ULC-S101 and as specified:

2.5.1.1. Flame Spread Rating: 25 or under to CAN/ULC S102.

2.5.1.2. Smoke Developed:50 or under to CAN/ULC S102.

2.5.1.3. Fire Rating: Class A

2.5.1.4. Acoustical Lay-In Panels in Corridors:

2.5.1.4.1. Basis of Design: “Radar Education Acoustic Panels”, by CGC:

2.5.1.4.2. Item no. 2407

2.5.1.4.3. Size: 24” x 48” x 5/8” thick

2.5.1.4.4. Edge: Square

2.5.1.4.5. Suspension grid: 15/16 in

2.5.1.4.6. Colour: 050 Flat White

2.5.1.4.7. Light Reflectance: 0.84

2.5.1.4.8. Ceiling Attenuation Class (CAC): 35

2.5.1.4.9. Noise Reduction Coefficient (NRC): Noise Absorption 0.55

2.5.1.4.10. Minimum Recycled Content: 26%

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.1.2. Do not start installation until exterior glazing has been completed and exterior openings are closed in. Ensure wet work is completed and dried out to a degree acceptable to panel manufacturer before installation is commenced. Maintain uniform temperatures of at least 21 deg C (72 deg F) for 72 hours prior to commencement of work and maintain temperature until 72 hours after completion.

3.1.3. Install ceiling panels and metal suspension system in accordance with applicable requirements of ASTM C636/C636M, seismic design and manufacturer's directions. Where manufacturer's directions are at variance with Contract Documents, notify Consultant before proceeding with work.

3.1.4. Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.

3.1.5. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION - SUSPENSION SYSTEM

3.2.1. Comply with manufacturer's installation instructions and recommendations, including product technical bulletins, installation instructions, and data sheets.

3.2.2. Install suspension system in accordance with accepted shop drawings, and ASTM C636/C636M except where specified otherwise.

3.2.3. Install suspension system by suspending ceiling hangers from building's structural members, and as follows:

3.2.3.1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

3.2.3.2. Attach hangers to structural members or intermediate structural supports.

3.2.3.3. Exposed Concrete Slab: Use anchors, cast-in hanger wires or inserts, specifically designed for hanger use. Do not use powder activated fasteners.

3.2.3.4. Suspension to Metal Floor Deck: Punch lower part of metal deck with special puncher at required distances. Put hanger wire through holes, turn down, make a loop and securely wrap 3 times.

3.2.3.5. Steel Beams: Use beam clips.

3.2.3.6. Steel Joists: Wrap hanger wire around lower chord member.

3.2.3.7. Permanent Metal Forms and Cellular Floor Deck: Tabs, holes or slots specifically provided for hanger attachment. Prevent hanger twisting or turning by cross tying.

3.2.4. If ductwork or equipment located in ceiling plenum area interferes with hanger spacing, provide a trapeze or other arrangement reviewed by Consultant to support main beams at proper spacing.

3.2.5. Do not secure hangers to metal roof deck, ductwork, conduit, piping, equipment or support system for any of these.

3.2.6. Provide an additional hanger at each corner of each opening to receive a recessed lighting fixture and each opening that has been framed by main beam members. Provide additional hangers at each diffuser, grille and other points of extra loading.

3.2.7. Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width.

3.2.8. Space hangers for suspended ceilings to support grillage independent of walls, columns, pipes and ducts at maximum 1220 mm (4') centres along support grillage and not more than 150 mm (6") from ends. Provide additional hangers at light fixtures and diffusers.

3.2.9. Run main tees at right angles to length of light fixtures.

3.2.10. Space main tees 1220 mm (4') oc in 1 direction and securely tie to hangers.

3.2.11. Space cross tees 610 mm (2') oc at right angles to main tees and properly lock at intersections.

3.2.12. Use longest practical lengths of tees, furring and running channels to minimize joints. Make joints square, tight, flush and reinforced with concealed splines. Assemble framework to form a rigid and interlocking system.

3.2.13. Use edge moulding where ceiling abutts vertical surface.

3.2.14. Use corner moulding along external edges at ceiling steps.

3.2.15. Level suspended systems with a maximum tolerance of 3 mm (1/8") over 3.66 m (12').

3.2.16. Expansion Joints:

3.2.16.1. Provide Z-shaped metal trim pieces at each side of expansion joint. Design to accommodate plus or minus 25-mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.

3.2.17. Fire-Resistance Rated Ceilings: Provide fire-resistance rated ceilings where required, including proper construction of framing and furring and proper thickness of acoustical units, to produce hourly fire-resistance ratings called for. Requirements for materials, methods of erection and application specified under appropriate headings of this Section apply, except where more stringent requirements are defined for particular fire-resistance rating by ULC.

3.3. INSTALLATION - ACOUSTICAL CEILING PANEL SYSTEM

3.3.1. Install lay-in acoustical panels in ceiling suspension system in accordance with manufacturer's instructions and as indicated.

3.3.2. Install panels with edges fully hidden from view by flanges of suspension system runners and mouldings.

3.3.3. In fire-rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

3.4. SITE QUALITY CONTROL

3.4.1. Site Test and Inspection:

3.4.1.1. After interior finishing work has been substantially completed, or when directed by Consultant, inspect acoustical treatment work.

3.4.1.2. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.

3.4.2. Manufacturer Services: Arrange for periodic site visits by manufacturer's representative to review installed work for conformity to manufacturer's installation instructions and recommendations.

3.4.2.1. Submit written site reports within three days of visit.

3.4.3. Non-Conforming Work:

3.4.3.1. Do not support ceilings directly from permanent metal forms, floor deck, or other non-structural framing.

3.4.3.2. Do not attach hangers to steel roof deck or steel deck tabs.

3.4.3.3. Do not level ceilings by putting kinks in suspension wires. Kinks in suspension wires are not acceptable.

3.4.3.4. Conceal fasteners including pop rivets on mouldings and trims.

3.4.4. Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.5. CLEANING

3.5.1. Clean exposed surfaces of acoustical panel ceilings, including trim and edge mouldings. Comply with manufacturer's written instructions for cleaning and touch-up of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned or repaired to permanently eliminate evidence of damage.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: Provide resilient base and accessories including but not limited to following:

1.1.1.1. Resilient base.

1.1.1.2. Reducing strips.

1.2. SUBMITTALS

1.2.1. Samples: Submit following samples in sizes indicated:

1.2.1.1. Resilient base 300 mm (12") long.

1.2.1.2. Reducing strips 300 mm (12") long.

1.3. SITE CONDITIONS

1.3.1. Ambient Conditions:

1.3.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions.

1.3.1.2. Close doors and windows. Turn off radiant floor heating systems and protect work area from direct draft, sun and heat exposure during installation and for at least 72 hours after completion.

1.3.1.3. When necessary, build a temporary shelter and use indirect auxiliary heaters to maintain an adequate temperature level in work environment.

1.3.1.4. Exhaust temporary heaters to building exterior to prevent health hazards and damage to work from toxic fumes and emanations.

1.3.1.5. Maintain temperature of floor covering areas at not less than 18 deg C (65 deg F) or more than 38 deg C (100 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

2.1.1.1. American Biltrite (Canada) Ltd.; www.american-biltrite.com

2.1.1.2. Burke Flooring, a Division of Burke Industries; www.burkeflooring.com

2.1.1.3. Flexco; www.flexcofloors.com

2.1.1.4. Johnsonite; www.johnsonite.com

2.1.1.5. Roppe Corporation, USA; www.roppe.com

2.1.1.6. Tarkett; www.tarkett.com

2.1.2. Substitution Limitations: Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification.

2.2. MATERIALS

2.2.1. Provide Products free from blisters, cracks, chipped edges, embedded foreign matter or other defects.

2.2.2. Resilient Base: 3 mm (1/8") thick x 150 mm (6") high in accordance with ASTM F1861, Type TS, Group 1, Style B, PVC-free vulcanized rubber, in coil lengths, colour selected from manufacturer's standard range.

2.2.2.1. Acceptable Products:

2.2.2.1.1. “Rubber Wall Base” by Johnsonite

2.2.2.1.2. “Marathon Cove Base” by American Biltrite (Canada) Ltd.

2.2.2.1.3. “PVC-Free Wallflowers Rubber Wall Base” by Flexco,

2.2.2.1.4. PVC-Free Burke Wall Base” by Burke Floors

2.2.2.1.5. “PVC-Free Pinnacle Rubber Wall Base” by Roppe Corporation, USA.

2.2.3. Reducing Strips: Vinyl, thickness to suit adjacent flooring; Johnsonite, American Biltrite (Canada) Ltd., Flexco or Roppe Corporation, USA.

2.2.4. Primers and Adhesives: As required for surfaces involved as recommended and supplied by resilient base manufacturer used.

2.2.5. Colours: Selected by Consultant from manufacturer's standard colour selection.

2.2.6. Sealant: ColorRite sealant, www.colorriteinc.com, color to match base.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

3.2.1. Resilient Base:

3.2.1.1. Provide resilient base to substrate surfaces in accordance with manufacturer's recommendations.

3.2.1.2. Select the appropriate adhesive for the application and job site conditions. Apply adhesive evenly and continuously for full base adhesion and contact. Do not apply adhesive in a manner which promotes induced waviness in resilient base.

3.2.1.3. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

3.2.1.4. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

3.2.1.5. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

3.2.1.6. Provide preformed inside and outside corners.

3.2.1.7. Do not stretch wall base during installation.

3.2.1.8. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

3.2.1.9. Ensure material is rolled appropriately into the adhesive using a hand roller.

3.2.1.10. Remove and replace base showing shrinkage or adhesion failure.

3.2.1.11. Apply sealant where base meets door frame.

3.2.2. Reducing Strips: Protect exposed edges of resilient flooring, where finished and unfinished area adjoin, by means of reducing strips butting to and flush with finished surface of floor covering material.

3.2.3. Remove and replace base showing shrinkage or adhesion failure.

3.2.4. Apply sealant where base meets door frame reveals.

END OF SECTION

PART 1 - General

1.1. SUMMARY

1.1.1. Section Includes:

1.1.1.1. Testing and preparation of substrate for installation of flooring.

1.1.1.2. Moisture vapour control topping.

1.1.1.3. Resilient vinyl tile flooring

1.1.1.4. Reducing strips and thresholds at junction with adjacent architectural finishes.

1.1.1.5. Resilient base.

1.1.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.1.2.1. Filling of major holes, chases and trenches in concrete substrate Flatness and levelness requirements for floor to receive resilient sheet flooring: Section 03 01 30 – Repairs to Concrete.

1.2. ADMINISTRATIVE REQUIREMENTS

1.2.1. Coordination:

1.2.1.1. Ensure that substrate treatments for moisture, repair, or levelling are compatible with the manufacturer of work in this Section.

1.2.2. Preinstallation Meeting:

1.2.2.1. Prior to start of work, arrange for site meeting of parties associated with work of this Section. Presided over by Contractor, include Consultant, Subcontractor, and manufacturer's representative.

1.2.2.2. Review work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials to be used, installation, methods and procedures, quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of this Section. Also discuss following items:

1.2.2.2.1. Surface preparation.

1.2.2.2.2. Concrete testing for RH, pH, and capillary moisture.

1.2.2.2.3. Installation.

1.2.2.2.4. Coordination with other Work.

1.3. SUBMITTALS

1.3.1. Make Submittals in accordance with Section Division 01 General Requirements

1.3.1.1. Product Data:

1.3.1.1.1. Submit manufacturer's product data sheets for products to be for used in the work of this section. Manufacturer's product data sheets shall include:

1.3.1.1.1.1. Material and product physical properties and characteristics including size and colour.

1.3.1.1.1.2. Limitations of products

1.3.2. Shop Drawings: Submit Shop Drawings for all areas indicating the following:

1.3.2.1. Each resilient floor tile type, installation method, locations of building movement joints, and intricate floor tile patterns.

1.3.2.2. Locations and types of edge strips and reducer strips at flooring penetrations.

1.3.3. Samples: Submit following samples in sizes indicated:

1.3.3.1. Resilient base 300 mm (12") long.

1.3.3.2. Reducing strips 300 mm (12") long.

1.3.4. Manufacturer's Instructions: Submit manufacturer's storage, handling, and installation instructions.

1.4. CLOSEOUT SUBMITTALS

1.4.1. Operating and Maintenance Data: Provide maintenance data for resilient flooring for incorporation into maintenance manual specified in Division 01. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.4.2. Record Documentation: Submit a list of materials installed, including adhesives, and accessories. Indicate manufacturers, products, types, patterns, and colour names and numbers. Indicate room/area where installed.

1.5. QUALITY ASSURANCE

1.5.1. Installers:

1.5.1.1. Provide work of this Section executed by competent installers with minimum of 5 years experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.

1.5.1.2. Submit documentation signed by the manufacturer to show that installers have been trained and meet their warranty criteria for installation requirements.

1.5.2. Mock-Up:

1.5.2.1. Construct one 10 sq.m. (100 sq.ft.) mock-up of each type and colour of resilient flooring in location acceptable to Consultant to demonstrate quality of finished work, complying with manufacturer's installation instructions and requirements of this Section and in accordance with Division 01 General Requirements.

1.5.2.2. Arrange for Consultant’s review and acceptance, obtain written acceptance before proceeding with Work.

1.5.2.3. Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the Work of this Section. Mock-up shall be left in place for the duration of the Work.

1.5.3. Bond Test:

1.5.3.1. Install multiple bond tests using selected tile adhered with the appropriate adhesive to verify quality of adhesion. Remove 1 tile after 24 hours, then another after 48 hours.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Delivery and Acceptance Requirements:

1.6.1.1. Deliver materials in good condition to site in manufacturer’s original unopened containers that bears name and brand of manufacturer, Project identification, shipping and handling instructions.

1.6.1.2. Deliver flooring material in a manner to avoid deterioration, staining or any other damage.

1.6.1.3. Deliver packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use.

Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes.

1.6.2. Storage and Handling Requirements:

1.6.2.1. Store and handle flooring material in a manner to avoid deterioration, staining or any other damage.

1.6.2.2. Store packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use. Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes. If materials are frozen, do not stir any such liquids or adhesives until they are completely thawed.

1.6.2.3. Provide secure heated and dry storage facilities on site. Maintain temperature in storage area between 18 deg C (65 deg F) and 38 deg C (100 deg F).

1.6.2.4. Store materials on site at least 24 hours before work begins.

1.7. SITE CONDITIONS

1.7.1. Ambient Conditions:

1.7.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions. Follow Product MSDS and label instructions concerning safety, health and other related precautionary and environmental protection. Comply with applicable federal, provincial, local and statutory regulations.

1.7.1.2. Close doors and windows. Turn off radiant floor heating systems and protect work area from direct draft, sun and heat exposure during installation and for at least 72 hours after completion.

1.7.1.3. When necessary, build a temporary shelter and use indirect auxiliary heaters to maintain an adequate temperature level in work environment.

1.7.1.4. Ventilation: Provide temporary ventilation:

1.7.1.4.1. Provide high ventilation rate with maximum outside air 24 to 48 hours before, during installation, and 48 to 72 hours after installation. If possible, vent directly to outside.

1.7.1.4.2. Do not let contaminated air recirculate through air distribution system. Continue high ventilation rate for at least four weeks after building occupation.

1.7.1.5. Maintain relative humidity in accordance with manufacturer's instructions.

1.7.1.6. Exhaust temporary heaters to building exterior to prevent health hazards and damage to work from toxic fumes and emanations.

1.7.1.7. Maintain temperature of floor covering areas at not less than 18 deg C (65 deg F) or more than 38 deg C (100 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

1.8. WARRANTY

1.8.1. Submit Warranty information in accordance with Division 01 General Requirements

1.8.2. Submit Applicator's written warranty, signed and issued in the name of Owner warranting the Work of this Section against defects in materials and workmanship for a period of 20 year from the date of Substantial Performance of the Work.

1.8.3. Warranty covers excessive wear, and defects in materials.

PART 2 - PRODUCTS

2.1. MATERIALS

2.1.1. Vinyl Tile Flooring:

2.1.1.1. Homogenous, vinyl tile floor covering.

2.1.1.2. Thickness 2 mm (0.08”) ASTM F386

2.1.1.3. Tile Size: 30cm x 30cm

2.1.1.4. Polyurethane Reinforced to ASTM F410

2.1.1.5. Tile Squareness: Passes ASTM F2055

2.1.1.6. Tile Dimensional Stability: Passes ASTM F2199

2.1.1.7. Flexibility: Passes ASTM F137

2.1.1.8. Static Load Limit: 250 psi ≤ 0.005” ASTM F970

2.1.1.9. Resistance to Heat: ΔE ≤ 8

2.1.1.10. Resistance to Light: ΔE ≤ 8 ASTM F1514

2.1.1.11. Clean Room: Class 4 ISO 14644-1

2.1.1.12. Slip Resistance: SCOF ≥ 0.5 ASTM D2047

2.1.1.13. Fire Performance to CAN/ULC S102.2:

2.1.1.13.1. FSR 15

2.1.1.13.2. SDC 125

2.1.1.14. Product shall have the ability to be dry buffed using a single disc, high speed, rotary machine at 1500 RPM and with no additional liquids, pastes or waxes as part of the maintenance or appearance retention process.

2.1.1.15. Basis of Design: “iQ Granit” by Tarkett; www.tarkettna.com colour: To be selected from standard colour plalette

2.1.2. Accessories:

2.1.2.1. Adhesive:

2.1.2.1.1. Water-resistant reactive adhesives or of types recommended by resilient homogenous flooring manufacturer for specific material on applicable substrate, above, on or below grade.

2.1.2.1.2. Vinyl Tile Flooring: “Tarkett 926 or 975 or 996” as recommended by the manufacturer.

2.1.2.2. Subfloor Filler and Leveler:

2.1.2.2.1. Fast setting, polymer-modified Portland cement based patching compound mixed with either a latex additive or water only depending on substrate conditions and Product instructions. “Self-Leveler Plus” by Mapei.

2.1.2.3. Reducing Strips: Vinyl, thickness to suit adjacent flooring.

2.1.2.4. Metal edge strips:

2.1.2.4.1. Aluminum extruded, smooth, mill finish and polished with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

2.1.3. Concrete Moisture Emission Reducer: Characteristics, performance requirements:

2.1.3.1. Epoxy cement, compliant with ASTM F3010.

2.1.3.2. Antimicrobial additive

2.1.3.3. Reduce the moisture vapour emission rate of concrete slabs ≤ 3 lbs. per 1,000 ft^2 per 24 hours.

2.1.3.4. Reduce the surface alkalinity of concrete slabs down to pH levels of 9

2.1.3.5. Provide 1 of following:

2.1.3.5.1. “Planiseal™ VS” by Mapei Corporation.

2.1.3.5.2. “Sikafloor® 81 EpoCemCA” by Sika Canada Inc.

2.1.3.5.3. “Ardex MC Rapid” by Ardex Canada

2.1.4. Resilient Base: 3 mm (1/8") thick x 102 mm (4") high in accordance with ASTM F1861, Type TS, Group 1, Style B, PVC-free vulcanized rubber, in coil lengths, colour selected from manufacturer's standard range.

2.1.4.1. Acceptable Products:

2.1.4.1.1. “Rubber Wall Base” by Johnsonite

2.1.4.1.2. “Marathon Cove Base” by American Biltrite (Canada) Ltd.

2.1.4.1.3. “PVC-Free Wallflowers Rubber Wall Base” by Flexco,

2.1.4.1.4. “PVC-Free Burke Wall Base” by Burke Floors

2.1.4.1.5. “PVC-Free Pinnacle Rubber Wall Base” by Roppe Corporation, USA.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions for New Concrete:

3.1.1.1. Ensure new concrete slab has been properly cured and dry for minimum of 28 Days and has reached minimum compressive strength of 25 MPa (3625 psi) and a minimum of 1.5 MPa (218 psi) in tension.

3.1.1.2. Ensure no curing and sealing compounds, hardeners or other chemical additives have been used on concrete.

3.1.1.3. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.2. TESTING FOR ALL CONCRETE FLOORS:

3.2.1. Conduct concrete testing on all concrete floors prior to application of moisture vapour control topping and following corrective work.

3.2.2. Moisture Vapour Testing:

3.2.2.1. Perform calcium chloride test no earlier than 28 Days after concrete has been placed in accordance with requirements of ASTM F1869 for new and existing concrete floors, and in-situ probe RH testing in accordance with ASTM F2170 for new concrete prior to installation of flooring material.

3.2.2.2. Conduct 3 tests for each of the RH test methods for first 93 m2 (1000 sq ft) and 1 additional test for every 93 m² (1000 sq ft) of flooring. Ensure moisture emission from concrete floor does not exceed 2.27 kg/93 m² (5 lbs/1000 sq ft) in 24 hours or has a maximum RH of 80%.

3.2.2.3. Provide results to Consultant prior to commencement of installation including diagram of area tested showing location of each moisture test.

3.2.2.4. When concrete moisture emission rate is between 2.27 kg/93 m² (5 lbs/1000 sq ft) and 6.79 kg/93 m² (15 lbs/1000 sq ft) and in 24 hours use a concrete moisture emission reducer.

3.2.2.5. Do not proceed with installation until moisture problem has been corrected.

3.2.3. Alkalinity Testing (pH):

3.2.3.1. Measure pH of concrete in accordance with ACI PRC-364.17: How to Measure pH of a Concrete Surface Prior to Installation of a Floor Covering.

3.2.3.2. Perform pH test no earlier than 28 Days after concrete has been placed to ensure alkali salt residue is within limitation acceptable to manufacturer and to avoid adhesive failure, discoloration, shrinkage and softening of floor covering. If pH results are higher than 9.0, report to Consultant, Contractor or Owner for investigation and remedial work.

3.2.3.3. Perform at least three pH tests must be performed for the first 93 m² (1,000 square feet) of space. One additional test should be performed for each additional 93 m² (1,000 square feet 0 thereafter.

3.2.3.4. Refer to manufacturer for ways to neutralize floor prior to beginning of installation. Neutralize by sanding, vacuuming and/or by water plus mild sulfuric or sulfamic acid application as recommended by manufacturer.

3.2.3.5. Retest to assure pH has been neutralized.

3.2.4. Capillary Moisture Testing:

3.2.4.1. Moisture content of concrete substrate must be ≤ 4 % by mass (PBW – part by weight) as measured with a Tramex®CME / CMExpert type concrete moisture meter.

3.2.4.2. Before proceeding with application, test surfaces for moisture content in accordance with ASTM D4263 and in consultation with manufacturer to ensure they are suitable for application.

3.2.4.3. Provide all test results to Consultant prior to commencement of installation including diagram of area tested showing location of each moisture test, alkalinity test and capillary moisture test.

3.2.5. Evaluation and Assessment:

3.2.5.1. Report all testing results to manufacturer's representative and submit written acceptance of these results approval before proceeding.

3.2.5.2. Commencement of work implies acceptance of previously completed work.

3.3. SURFACE PREPARATION

3.3.1. For all new and existing concrete floor areas:

3.3.1.1. Prepare existing and new concrete floors over entire area with steel shot blasting or other method recommended by manufacturer. Remove uneven joints, rough areas, foreign and projection off surfaces. Surface to be hard, sound and roughened to irregular surface with weak concrete removed and surface holes and voids exposed. Equip dry blasting machine with vacuum to minimize dust.

3.3.1.2. Shot blast floor to remove soft material and to achieve a profile equivalent to ICRI / CSP 3 – 4.

3.3.1.3. Shot blast to expose cracks in concrete surface. For cracks lesser than 1.5 mm (1/16") employ crack reinforcing tape in accordance manufacturer’s recommendations. Repair cracks, holes or other deficiencies in accordance with manufacturer's recommendations.

3.3.1.4. Blow clean control joints, sawcuts and cracks with compressed air.

3.3.1.5. Prepare concrete floors to receive sheet flooring in accordance with requirements of ASTM F710. Achieve CSP of #2 - #3. Consult individual manufacturer for their specific recommendations and follow them as required.

3.4. MOISTURE BARRIER APPLICATION

3.4.1. If moisture levels exceed acceptable limit, apply moisture emission reducer in accordance with ASTM F710 and ASTM F3010.

3.4.2. Follow manufacturer's recommendations to determine whether cracks are filled before or after application of moisture barrier cement.

3.4.3. Mix moisture barrier in accordance with manufacturer's printed instructions.

3.4.4. Material components minimum 15°C (60°F) at time of mixing.

3.4.5. Apply coating using roller to achieve thickness as per manufacturer's instructions. Allow to cure.

3.4.6. Apply second coat of moisture barrier coating, dry film thickness of 12.8 mils. Allow to cure.

3.4.7. Re-test for moisture vapour emission and pH level.

3.5. INSTALLATION - GENERAL

3.5.1. Install materials of this section in accordance with material manufacture's written requirements.

3.5.2. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation. Do not install resilient products until they are same temperature as space where they are to be installed.

3.5.3. Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and permanently stain the flooring material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the flooring material.

3.5.4. Terminate vinyl tile in straight lines at centreline of door in openings where adjacent floor finish or vinyl composite tile colour is dissimilar.

3.5.5. At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide patching and levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper patching and levelling compound to transition with adjacent flooring substrate to be provide smooth and seamless transition at maximum slope of 3:1000 (height to distance) ratio.

3.5.6. Install vinyl tile accurately fitted at perimeter of rooms, cut with precision at columns, door frames and at other obstructions.

3.5.7. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

3.5.8. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

3.5.9. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of floor coverings installed on covers. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

3.5.10. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5.11. Allow no traffic over installation until adhesives have fully cured, minimum twenty-four (24) hours.

3.6. INSTALLATION – TILE

3.6.1. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

3.6.2. Lay tiles square with room axis, unless otherwise indicated or directed.

3.6.3. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

3.6.4. Lay tiles with grain running in one direction as indicated on drawings.

3.6.5. Lay tiles in Ashlar pattern.

3.6.6. Tiles to be rolled with a 3 section coated 100 lb roller in accordance with manufacturer's installation instructions.

3.6.7. Finished flooring installation shall not show telegraphing of defects in substrate. Finished flooring installation shall be homogenous free of substrate lines, adhesive trowel lines, pockets, bumps and unevenness which are outside of specified tolerances.

3.6.8. Reducing Strips: Protect exposed edges of resilient flooring, where finished and unfinished area adjoin, by means of reducing strips butting to and flush with finished surface of floor covering material.

3.7. INSTALLATION - BASE

3.7.1. Install material in accordance with manufacturer's recommendations.

3.7.2. Select the appropriate adhesive for the application and job site conditions.

3.7.3. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

3.7.4. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

3.7.5. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

3.7.6. Do not stretch wall base during installation.

3.7.7. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

3.7.8. Ensure material is rolled appropriately into the adhesive using a hand roller.

3.7.9. Remove and replace base showing shrinkage or adhesion failure.

3.7.10. Apply sealant whee base meets door frame reveals.

3.8. CLEANING

3.8.1. Remove excess adhesive from floor, base and wall surfaces without damage.

3.8.2. Clean floor and base surface to flooring manufacturer's instructions.

3.8.3. Perform the following operations immediately after completing resilient product installation:

3.8.3.1. Remove adhesive and other blemishes from exposed surfaces.

3.8.3.2. Sweep and vacuum surfaces thoroughly.

3.8.3.3. Damp-mop surfaces to remove marks and soil.

3.8.4. Do not wash surfaces until after time period recommended by manufacturer.

3.9. PROTECTION

3.9.1. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

3.9.2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Performance.

3.9.3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

3.9.4. Prohibit foot traffic on floor for 24 hours after installation. Prohibit heavy traffic, rolling loads and furniture or appliance placement for a minimum of 72 hours after installation.

END OF SECTION

PART 1 - General

1.1. SUMMARY

1.1.1. Section Includes: Provide resilient rubber flooring tiles including but not limited to following:

1.1.1.1. Preparing substrate.

1.1.1.2. Resilient sheet impact flooring for glue down installation.

1.1.1.3. Adhesive and accessories required for installation and maintenance.

1.1.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.1.2.1. Concrete floor finishing: Section 03 01 30 – Repairs to Concrete.

1.1.2.2. Concrete floor testing: Section 09 05 61 – Common Work Results for Flooring Preparation

1.2. ADMINISTRATIVE REQUIREMENTS

1.2.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week before commencing work with all parties associated. Review work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.2.2. Coordination: ensure concrete floor is mechanically prepared by grinding or shot blasting to CSP1 surface.

1.3. SUBMITTALS

1.3.1. Shop Drawings:

1.3.1.1. Submit Shop Drawings for all areas showing seam layout for major seams between rolls, coving details, treatment at walls, floor drains, treatment where flooring meets dissimilar materials and other special conditions.

1.3.2. Samples:

1.3.2.1. Submit duplicate 300 mm x 300 mm (12" x 12") sample pieces of sheet material.

1.3.2.2. Submit 300 mm (12”) long samples for welding rod, each type of seam specified, to indicate quality of joint treatment and each type of flooring accessory.

1.3.2.3. Submit sample of reducing strips 300 mm (12") long.

1.4. CLOSEOUT SUBMITTALS

1.4.1. Operating and Maintenance Data: Provide maintenance data for resilient sheet rubber flooring for incorporation into maintenance manual specified in Division 01.

1.5. QUALITY ASSURANCE

1.5.1. Qualifications:

1.5.1.1. Installers: Provide work of this Section executed by competent installers with minimum of 5 years experience in application of Products, systems and assemblies specified, including 2 years in heat welding of seams and with approval and training of Product manufacturer. Upon request, provide proof of manufacturer’s certificate prior to commencement of installation.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Delivery and Acceptance Requirements:

1.6.1.1. Deliver materials in good condition to site in manufacturer's original unopened containers that bears name and brand of manufacturer, Project identification, shipping and handling instructions.

1.6.1.2. Deliver packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use. Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes.

1.6.1.3. Deliver materials on site at least 24 hours before work begins.

1.7. SITE CONDITIONS

1.7.1. Ambient Conditions:

1.7.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions. Follow Product MSDS and label instructions concerning safety, health and other related precautionary and environmental protection. Comply with applicable federal, provincial, local and statutory regulations.

1.7.1.2. Close doors and windows. Turn off radiant floor heating systems and protect work area from direct draft, sun and heat exposure during installation and for at least 72 hours after completion.

1.7.1.3. Maintain temperature of floor covering areas at not less than 18 deg C (65 deg F) or more than 30 deg C (86 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

1.8. WARRANTY

1.8.1. Manufacturer Warranty: Warrant work of this Section for period of 15 years against defects and/or deficiencies. Promptly correct any defects or deficiencies which become apparent within correction period. Defects include but are not limited to; cracking, chipping, excessive wear, and extensive colour fading.

PART 2 - Products

2.1. MANUFACTURERS

2.1.1. Manufacturer: Basis of Design: "Recreation 60" by Gerflor; www.gerflorcanada.com

2.1.2. Substitution Limitations: Comparable Products from other manufacturers not listed herein will be considered provided they meet requirements of this Specification after full review by Consultant.

2.2. PERFORMANCE/DESIGN CRITERIA

2.2.1. Resilient sheet athletic flooring composed of PUR surface treatment, PVC surface complex, fibreglass grid reinforcement, and closed cell foam backing to ASTM F1303 Type 1 , Grade 1

2.2.2. Heat welded seams

2.2.3. Overall thickness: 6.0 mm

2.2.4. Wear layer thickness: 1.5 mm

2.2.5. ASTM F2722 Class 2 shock absorption

2.2.6. ISO 22196: Inhibits spread of bacteria at 99%

2.2.7. 33% recycled content, 100% recyclable

2.2.8. Fire Rating: ASTM E648 - Class 1

2.2.9. Product model, pattern and colours to be determined by Consultant

2.3. MATERIALS

2.3.1. Adhesive: pressure sensitive adhesive “Gerfix TPS+” by Gerflor

2.3.2. Weld rods: as per approved sample

PART 3 - Execution

3.1. INSTALLATION

3.1.1. Install underlayment then cement board then impact flooring. Complete installation in accordance with manufacturer’s instructions.

3.1.2. Mark the centre lines of the room and starting line. Sheet direction as per reviewed shop drawing.

3.1.3. Full spread adhesive in accordance with manufacturer’s printed instructions.

3.1.4. Follow roll sequence numbers. Random match side seams

3.1.5. Heat Elding Seams:

3.1.5.1. Grooving and welding may proceed after the adhesive has been permitted to cure a minimum of 16 hours

3.1.5.2. Heat welding in accordance with ASTM F1516 Standard Practice for Sealing Seams of Resilient Flooring by the Heat Weld Method

3.1.5.3. Rout groove to reach the top of the foam backing. Careful to not groove into the foam.

3.1.5.4. Maximum width of groove 4 mm

3.1.5.5. Verification of welder temperature and speed must be performed daily. Confirm temperature and speed by practicing on scrap material first before deploying the welder to the finished floor.

3.1.5.6. Use a heat welding gun with variable temperature control and a speed weld nozzle by Leister or equal.

3.1.5.7. Automatic welder: Turbo Welding Gun #25. www.turboheatweldingtools.com

3.1.5.8. Trim weld rod in accordance with printed instructions.

END OF SECTION

PART 1 - GENERAL

1.1. SUMMARY

1.1.1. Section Includes: painting new and existing surfaces as indicated on the drawings and specifications. Work under this contract shall also include, but not necessarily be limited to following:

1.1.1.1. Surface preparation of substrate: cleaning and preparation of surfaces for application of paint systems.

1.1.1.2. Priming except where pre-primed with an approved primer under other Sections of work and painting of structural steel, miscellaneous metal, ornamental metal and primed steel equipment.

1.1.1.3. Priming and back-priming of wood materials as noted herein.

1.1.1.4. Painting of all semi-concealed areas e.g. inside of light troughs and valances, behind grilles, and projecting edges above and below sight lines.

1.1.1.5. Painting and finishing of all door frames.

1.1.1.6. Provision of safe and adequate ventilation as required over and above temporary ventilation supplied by others, where toxic and/or volatile / flammable materials are being used.

1.2. REFERENCES

1.2.1. Definitions:

1.2.1.1. Exposed: Visible in completed work. In case of closets, cabinets and drawers, it includes their interiors.

1.2.1.2. Gloss or Sheen: Capacity of a finish on a surface to reflect light at specific angles as tested in accordance with ASTM D523.

1.2.1.3. Hazardous Waste: Construction and demolition materials that are regulated for disposal by local, city, county, province or federal authorities having jurisdiction.

1.2.1.4. Painting: In this Section refers to application of various types of paint, stain, varnishes and lacquers, etc.

1.2.1.5. Surface Preparation: Cleaning or treating of surface to be painted to ensure best possible bond between surface and painting to be applied to surface; remove surface contaminants that will affect performance of painting, without limitations such as oil, grease, salts, dust, dirt, rust, rust scale, mill scale and old coatings where applicable; remove surface imperfections without limitation including but not limited to such as weld spatter, sharp edges, burrs, slivers, laminations, pits, porosities and crevices; prepare surfaces to provide anchor profile or surface profile which improve mechanical bonding of coating to prepared surface by increasing surface area.

1.3. SUBMITTALS

1.3.1. Product Data:

1.3.1.1. Submit Product data and a Schedule of Finishes listing manufacturer's Product name, colour, textures, MSDS and test reports requested for each paint system. Submit test reports for odourless, low or zero VOC Products when requested.

1.3.1.2. Painting Subcontractor to receive written confirmation of specific surface preparation procedures and primers used for fabricated steel items from fabricator/supplier to ensure appropriate and manufacturer compatible finish coat materials prior to commencement of painting.

1.3.1.3. Submit Product data for concrete and concrete block primers.

1.3.2. Samples: Submit samples 30 Days before materials are required.

1.3.2.1. Submit following samples in sizes indicated:

1.3.2.1.1. 2 copies of brushouts minimum 200 mm x 250 mm (8" x 10") of each finish including colour, sheen and texture. Identify each sample with job, finish, colour name, number, sheen and gloss values, substrate to be applied to, date and name of Subcontractor.

1.4. SITE CONDITIONS

1.4.1. Ambient Conditions:

1.4.1.1. Paint and finish in clean, dust-free, properly ventilated and adequately lit areas minimum 323 Lx (30 ft candles) on surfaces to be painted or decorated.

1.4.1.2. Provide each paint materials in accordance with manufacturer's recommended tolerances for:

1.4.1.2.1. Substrate Moisture Content: Perform tests with a properly calibrated electronic moisture meter to ensure compliance with manufacturer’s recommendations. Without limitation, maximum moisture content as follows:

1.4.1.2.1.1. Concrete and Concrete Unit Masonry: Maximum 12 - 14% for solvent coatings and as recommended by manufacturer for each water based system.

1.4.1.2.1.2. Gypsum Based Board and Plaster: Maximum 12 - 14%.

1.4.1.2.1.3. Wood: Maximum 15%.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications

2.1.1.1. Benjamin-Moore www.benjaminmoore.com

2.1.1.2. Dulux Paints www.dulux.ca

2.1.1.3. Sherwin Williams www.sherwin-williams.com

2.1.2. Basis of Design: for interior latex applications (PT-1): “Promar 200 HP Zero VOC” by Sherwin Williams

2.1.3. Substitution Limitations: Substitution Limitations: Comparable Products from other manufacturers not listed herein will be considered provided:

2.1.3.1. They are submitted in accordance with Substitution Procedures specified in Division 01

2.1.3.2. Meet requirements of this Specification.

2.1.3.3. Acceptance by Consultant.

2.2. MATERIALS

2.2.1. General: paint systems for existing surfaces shall be same finish system as for new work as specified below, but primer for existing painted or wallpapered surfaces: 1 coat X-Pert Gripper 250 by PPG, or as otherwise recommended by the finish paint manufacturer.

2.2.2. Finishes:

2.2.2.1. Colours: to be selected by Consultant

2.2.2.2. Gloss Values Definition, as determined by ASTM D523:

		Light Reflection Unit
G1	Gloss Level 1 – Traditional matte finish, Flat	< 5
G2	Gloss Level 2 – High side sheen Flat, “Velvet-like” finish	< 10
G3	Gloss Level 3 – Traditional “Eggshell-like” finish	10 - 25
G4	Gloss Level 4 – “Satin-like” finish	20 - 35
G5	Gloss Level 5 – Traditional Semi-Gloss	35 - 70
G6	Gloss Level 6 – Traditional Gloss	70 - 85
G7	Gloss Level 7 – High Gloss	> 85

2.2.2.3. Gloss Values unless otherwise specified:

2.2.2.3.1. Walls: G4

2.2.2.3.2. Floors: G5 or G6

2.2.2.3.3. Ceilings: G1

2.2.2.3.4. Trim and Doors: G5

2.2.2.3.5. Signage: G1

2.2.3. Mixing and Tinting:

2.2.3.1. Unless otherwise specified herein or pre-approved, all paint shall be ready-mixed and pre-tinted. Re-mix all paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and color and gloss uniformity.

2.3. INTERIOR FINISH SCHEDULE:

2.3.1. Concrete Vertical Surfaces:

2.3.1.1. 1 coat primer alkali resistant water based: Dulux Gripper Universal Acrylic Primer/ Sealer code 60000A

2.3.1.2. 2 coats latex: Dulux Lifemaster code 59311

2.3.1.3. Finish: G3 -Eggshell.

2.3.2. Concrete Masonry Units (CMU’s): (concrete block and concrete brick):

2.3.2.1. 1 coat latex block filler: Dulux X-Pert Acryluc

2.3.2.2. 2 coats latex: Dulux Lifemaster code 59311

2.3.2.3. Finish: G3 -Eggshell.

2.3.3. Structural Steel and Metal Fabrications: (with existing shop coat primer):

2.3.3.1. Unexposed: No further finishing required except for touch-up of damaged surfaces.

2.3.3.2. Exposed:

2.3.3.2.1. 1 coat quick dry metal primer: PPG Pitt-Tech Plus EP WB Acrylic Primer

2.3.3.2.2. 2 coats quick dry enamel: PPG HPC Alkyd Industrial Semi-Gloss Enamel code 4336H

2.3.3.2.3. Finish: G5 - Semi-Gloss.

2.3.4. Galvanized Metal (Not Chromate Passivated): (High contact/high traffic areas (doors, frames, railings, pipes, etc.) low contact/low traffic areas (overhead decking, pipes, ducts, etc.):

2.3.4.1. 1 coat waterborne primer: PPG Pitt-Tech Plus EP WB Acrylic Primer

2.3.4.2. 2 coats latex: Dulux acrylic eggshell code 14220

2.3.4.3. Finish: G3 - Eggshell

2.3.5. Gypsum Board:

2.3.5.1. 1 coat latex primer sealer: Dulux X-Pert code 11000

2.3.5.2. 2 coats latex:

2.3.5.2.1. Walls: Dulux Lifemaster code 59311

2.3.5.2.1.1. Finish: G3 - Eggshell

2.3.5.2.2. Ceilings: Dulux Lifemaster code 59111

2.3.5.2.2.1. Finish: G1 - Flat.

2.3.6. Plywood Backer Panels:

2.3.6.1. 2 coats Albi Cote FRL-X

2.3.6.2. Finish: G1 – Flat

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions:

3.1.1.1. Do work only when surfaces and conditions are satisfactory for production of quality work. Report to Consultant in writing any surfaces which are found to be unsatisfactory.

3.1.1.2. Ensure temperature of surfaces to be finished are as required for application of finish. Refer to “Temperature and Ventilation” article specified herein. Ensure surfaces are dry and free of dirt, grease or other contaminants that may affect applied finish.

3.1.1.3. Verify moisture content of surfaces with electronic moisture meter. Do not proceed without written directions if moisture reading is higher than as required for application. Refer to “Ambient Conditions” article specified herein for substrate moisture content requirements.

3.1.1.4. If substrate is masonry, allow to cure for 30 to 90 Days. Ensure moisture content is between 12% and 14% and test for alkalinity and neutralize (pH 6.5 - 7.5) before proceeding with priming.

3.1.1.5. If substrate is gypsum board, inspect to ensure joints are completely filled and sanded smooth. Inspect surfaces for "nail popping", screw heads not recessed and taped, breaks in surface or other imperfections and have repaired as required.

3.2. PREPARATION

3.2.1. Protection of In-Place Conditions:

3.2.1.1. Provide scaffolding, staging, platforms and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with Occupational Health and Safety Act.

3.2.1.2. During work of this Section, provide drop cloths, plastic, plywood or metal sheets to protect floors in areas assigned for storage and mixing of paints. Cover finished floors, walls, ceilings and other work in vicinity and protect from paint and damage.

3.2.1.3. Protect work of other trades against paint splattering and Make Good at own expense any such damage.

3.2.1.4. Vacuum clean floors in areas to be painted.

3.2.1.5. Remove and securely store miscellaneous and finish hardware and surface fittings, electrical switch and outlet covers, receptacle plates, louvres, fittings and fastenings, to protect from paint splatter. Mask items not removable. Use sufficient drop cloths and protective coverings for full protection of floors, furnishings, mechanical, electrical and special equipment, other components of building which do not require painting or to be removed, from paint spotting and other soiling. Carefully clean and re-install items when paint is dry. Clean any components that are paint spotted or soiled. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes).

3.2.1.6. Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured. Post “wet paint” or other warning signage during and on completion of work. Provide also warning signs at points of entry to areas where painting is applied and drying.

3.2.2. Surface Preparation:

3.2.2.1. Prepare defective surfaces to obtain a satisfactory substrate and in accordance with paint manufacturer's instructions.

3.2.2.2. Prior to painting, wipe down wall surfaces, vacuum clean floors, ensure all surfaces are dust-free.

3.2.2.3. Clean soiled surfaces to be painted. Wash existing surfaces with a biodegradable detergent, and bleach where applicable, and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants. Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface. Allow surfaces to drain completely and allow to dry thoroughly.

3.2.2.4. Remove efflorescence, chalk, dust, dirt, oil, grease, rust, form oil, release agents, loose mill scale and other extraneous matter from surfaces.

3.2.2.5. Remove mildew by scrubbing affected area with solution of 150 g (5.3 oz) TSP and 125 g (4.4 oz) bleach in 3.5 ℓ (0.92 gal) water. Rinse well with clean water and allow to dry. If condition is serious, source out finishes with extra mildew resistance.

3.2.2.6. Be responsible for surface preparation to suit surface condition and conform to level of cleaning based on SSPC, recommended metal cleaning procedures most commonly used to suit site conditions.

3.2.2.7. Existing surfaces - general: Remove or set screws, nails, hooks, tacks, and fasteners. Make repairs to damaged surfaces.

3.2.2.7.1. Existing gypsum board: Repair cracks and fissures by cutting away broken, damaged or loose material to expose substrate. Fill crack or damaged area with suitable new material in accordance with Section 09 29 00 – Gypsum Board.

3.2.2.8. Concrete and Masonry:

3.2.2.8.1. Form Oil Removal: Remove with Xylol or TSP.

3.2.2.8.2. Efflorescence Removal: Remove by dry brushing or washing with 1 part commercial muriatic acid to 20 parts water by volume and thoroughly rince with clean water.

3.2.2.8.3. Mildew Removal: Remove by scrubbing affected area with 1 part sodium hypochlorite to 3 parts water. Where dirt is also evident, add 1.36 kg (3 lbs) TSP to 6.8 ℓ (1.5 gal) of above solution.

3.2.2.8.4. Concrete Vertical Surfaces: Use sand blasting, high pressure water blasting, high pressure water blasting with abrasives, vacuum blasting with abrasives or alternatively, needle guns or power grinders equipped with suitable grinding stone, to remove concrete, loose mortar, fins, projections and surface contaminants. Vacuum or blow down and remove dust and loose particles from surface. Fill large cracks and/or voids in consultation with design engineer using either polyester, epoxy or acrylic resin, block filler or cement sand mixture in accordance with design engineer's written instructions. Fill only flush to surface and allow to set.

3.2.2.8.5. Concrete Block Masonry: Fill voids and cracks in masonry block wall to provide uniform surface for subsequent coats.

3.2.2.9. Metals:

3.2.2.9.1. Ensure application of paint and coatings occurs within appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.

3.2.2.9.2. SSPC-SP 3 (Power Tool Cleaning): Use of power sanders and wire brushes, impact tools, grinders and power chipping hammers to remove loose mill scale, loose rust, paint or other foreign matter. Do not employ power tool cleaning excessively causing burnished mill scale preventing primers to adhere properly.

3.2.2.9.3. Ferrous Metal: Clean to SSPC-SP 1/2/3, to suit site conditions. Remove loose rust and prime bare metal with rust inhibitive steel primer. Touch-up damaged shop applied primer using compatible Product. Provide full coat primer only if damage is extensive. Treat weld areas with phosphoric acid (5% solution).

3.2.2.9.4. Structural Steel/Miscellaneous Steel (previously painted and exposed by alterations work): Remove oil, grease, dirt, rust scale, loose mill scale, loose paint or coating by brush-off blast cleaning to SSPC-SP 7.

3.2.2.9.5. Hot Dipped Galvanized Steel (Unweathered): Allow to weather minimum of 26 weeks and Xylene clean to SSPC-SP 1 specified herein prior to coating to remove dust, dirt, grease, oxides and other foreign material. Remove silicates or similar surface treatments or any deposits of white rust by sanding or similar abrasive methods (bronze wool). Use of acetic acid to prepare galvanized surfaces is not acceptable.

3.2.2.9.6. Galvanized Steel (Weathered): Remove dust, dirt, grease, oxides and other foreign material and clean to SSPC-SP 1 specified herein prior to coating.

3.2.2.9.7. Galvanized Steel (Pre-Treated)(Non-Crystal Appearance): Follow manufacturer's recommendations for preparation, priming and coating of pre-treated galvanized steel.

3.2.2.9.8. Light Zinc Coated or Satin Coated Products (ZF075) mostly found in environmentally controlled areas. Follow manufacturer's recommendations for preparation, priming and coating.

3.2.2.9.9. Heavy Coated Zinc Z275 (G90) for high humidity areas and as specified. Follow manufacturer's recommendations for preparation, priming and coating.

3.2.2.9.10. Metal Doors: Remove doors before painting to paint bottom and top edges and re-hang once dry. Do not paint stainless steel or bronze door butts. Paint or

finish top and bottom edges of doors. Touch-up or refinish tops and edges after fitting.

3.2.2.10. Previously Finished Surfaces:

3.2.2.10.1. Clean existing interior and exterior surfaces to be repainted or varnished to provide bond. Remove rust, scale, oil, grease, mildew, chemicals and other foreign matter. Remove loose paint and fill flush with suitable patching material. Clean off bubbled, cracked, peeling or otherwise defective paint by stripping with suitable environmental strippers or by burning. Do not burn off paints suspected of having lead content. Treat residue from stripping as Hazardous Waste.

3.2.2.10.2. Flatten gloss paint and varnish with sandpaper and wipe off dust. If previous coatings have failed so as to affect proper performance or appearance of coatings to be applied, remove previous coatings completely and prepare substrates properly and refinish as specified for new work.

3.2.2.10.3. Remove or set screws, nails, hooks, tacks, and fasteners. Make repairs to damaged surfaces.

3.2.2.10.4. Existing gypsum board: Repair cracks and fissures by cutting away broken, damaged or loose material to expose substrate. Fill crack or damaged area with suitable new material in accordance with Section 09 29 00 – Gypsum Board.

3.2.2.10.5. Leave entire surface suitable to receive designated finishes and in accordance with finish manufacturer's instructions.

3.2.2.11. Woodwork:

3.2.2.11.1. Verify and determine wood species, grain direction and structure, properties of finish, application method and exposure to elements. Check moisture content to avoid movement of wood caused by expansion and contraction due to changes in moisture content. Verify grain cut as it may interfere with adhesion of paint.

3.2.2.11.2. Apply wood finishing Product in following order and as needed for specific appearance and application specified herein. Sanding sealer to control penetration of subsequent coats to create more uniform finish. Stain to colour wood and highlight grain for final finish. Filler to fill pores of wood and control penetration of subsequent coats. Apply filler across grain forcing it into pores followed with rubbing and sanding when dried. For staining requirements mix stain with filler before applying for uniform finish. Finish coats to provide protection to wood.

3.2.2.11.3. Wood work for Opaque Coating: Seal knots and sapwood in surfaces to receive paint with alcohol-based primer-sealer. Seal door edges. Sand smooth rough surfaces of woodwork to be finished using No. 150 grit paper followed by a second sanding using No. 220 grit paper. Sand in direction of grain. Clean surfaces free of dust before applying first coat using brush, compressed air or tack rags. Fill nail holes, splits and scratches with non-shrinking filler after first coat is dry.

3.2.2.11.4. Prepare plywood surface by removing dirt and debris. Fill screw and nail holes or minor imperfections with recommended filler and sand properly to receive finish coating. Ensure plywood requiring stained or painted finish is primed with top quality alkyd primer. Use only penetrating quality stain over plywood.

3.2.2.11.5. Woodwork for Clear Finish or Stain: Sand smooth woodwork to be finished using No. 150 grit paper followed by a second sanding using No. 220 grit paper and clean surfaces free of dust using brush, compressed air or tack rags before applying first coat. Abrade surfaces with stiff brush to remove loose fibres and splinters. Fill nail holes, splits and scratches with non-shrinking filler tinted to

match local grain condition after first coat is dry. Sand lightly between coats with No. 220 grit sandpaper and remove dust.

3.2.2.11.6. Remove salt deposits that may appear on wood surfaces treated with fire retarder.

3.2.2.11.7. Obtain inspection of glue laminated beams by assigned painting inspector to ensure shop sealer has been applied. Where non-specified shop sealer has been applied to beams or columns, remove and refinish in accordance with manufacturer's written instructions.

3.2.2.11.8. Wood Doors: Remove doors before painting to paint bottom and top edges and re-hang once dry. Paint or finish top and bottom edges of doors to be painted or stained. Touch-up or refinish tops and edges after fitting.

3.2.2.12. Gypsum Board:

3.2.2.12.1. Examine and ensure gypsum board surfaces are without defects or deficiencies and suit able to receive painting applications. Commencement implies acceptance of gypsum board work. Examine surfaces after for imperfections showing through and fill small nicks or holes with patching compound and sand smooth. Examine surfaces after priming for imperfections showing through.

3.2.2.12.2. Clean surfaces dry, free of dust, dirt, powdery residue, grease, oil, wax or any other contaminants.

3.3. APPLICATION

3.3.1. Safety Precautions: When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do not provide protection from vapours.

3.3.2. Material Compatibility: Provide primers and finish coat materials compatible with each other and substrate including fillers.

3.3.3. Obtain colour chart giving colour schemes and gloss value for various areas from Consultant. Ensure colour chart gives final selection of colours and surface textures of finishes and whether finishes are transparent (natural) or opaque (paint).

3.3.4. Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.

3.3.5. Apply materials in accordance with manufacturer's directions and specifications paying particular attention to appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications. Do not use adulterants. Do any reduction of coating’s viscosity in accordance with manufacturer’s directions.

3.3.6. Use up paints within period of shelf life recommended by paint manufacturer.

3.3.7. Ensure successive coatings are harmonious chemical compositions and materials of same manufacturer.

3.3.8. Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.

3.3.9. Primer/Sealers: Apply primer-sealer coats by brush or roller. Permit to dry in accordance with manufacturer’s recommendations before applying succeeding coats. Touch up suction spots and sand between coats with No. 120 sandpaper.

3.3.10. Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1 m (39").

3.3.11. Ensure each coat is dry and hard before a following coat is applied.

3.3.12. Continue through paint finish behind wall-mounted items (e.g. chalk and tack boards).

3.3.13. Finish listed surfaces indicated on Room Finish Schedule(s) and/or noted on Drawing(s) and as specified. Refer to Finish Room Schedule for type, location and extent of finishes required and include touch-ups and field painting necessary to complete work shown, scheduled or specified.

3.3.14. Finishes and number of coats specified in Room Finish Schedule are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimum coverage and appearance. Some materials and colours may require additional coats and deeper colours may require use of manufacturers' special tinted primers. Apply additional paint coats, beyond number of coats specified for any surface, to completely cover and hide substrate and to produce a solid, uniform appearance

3.3.15. Painting previously painted surfaces:

3.3.15.1. Paint entire plane of wall or ceiling.

3.3.15.2. Where there has been patching or repair work – paint entire plane of wall or ceiling. Patching is not acceptable.

3.3.16. Do not paint baked paint surface, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint primed surfaces.

3.3.17. Metals:

3.3.17.1. Apply primer coat to unprimed ferrous metal surfaces. Where sandblast preparation is specified, apply specified primer immediately after blast cleaning.

3.3.18. Woodwork:

3.3.18.1. Fill open grain woods with filler tinted to match wood and work well into grain. Wipe excess from surface before filler sets.

3.3.18.2. Sand smooth paint and varnish undercoats prior to recoating.

3.3.18.3. Prime woodwork designated for painting as soon as possible after delivery to site and before installation. Prime cut surfaces, whether exposed or not, i.e. 6 edges of wood doors, before installation. Prime cut surfaces of woodwork to receive transparent finish with 1 coat of transparent finish reduced 25% or as directed by manufacturer.

3.3.18.4. Apply final coats on smooth surfaces by roller or brush. Hand brush wood trim surfaces.

3.3.19. Allow each coat of paint to cure and become dry and hard before application of succeeding coats (unless manufacturer's directions require otherwise).

3.3.20. Before finishing paint coats are applied, inspect and touch-up shop coats of primers previously applied by other trades or fabricators.

3.3.21. Provide paint coating thicknesses indicated, measured as minimum DFT.

3.3.22. Apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.

3.3.23. Ledges: Finish projecting ledges, both above and below sight lines, as specified for adjacent surfaces.

3.3.24. Light Coves: Paint light coves white whether a light lens is installed or not, unless otherwise indicated.

3.3.25. Interior Columns: Finish interior columns same as walls of room unless otherwise indicated.

3.3.26. Mechanical and Electrical Services:

3.3.26.1. Co-ordinate painting of mechanical and electrical equipment, piping, conduit, system Identification with appropriate Mechanical and Electrical Specification Sections. Unless otherwise specified or noted, paint "unfinished" conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, where exposed-to-view in exterior and interior areas.

3.3.26.2. Prime and paint exposed, unfinished electrical raceways, fittings, outlet boxes, junction boxes, pull boxes and similar items.

3.3.26.3. Take steps to protect gauges, identification plates and similar items from being painted over or paint splattered.

3.3.26.4. Remove grilles, covers, access panels for mechanical and electrical systems from installed location and paint separately, if these items are not factory finished. Paint adjacent surfaces after removal and reinstall when surfaces are dry.

3.3.26.5. Paint work to match surfaces they are seen against unless directed otherwise.

3.3.26.6. Paint interior surfaces of air ducts visible through grilles and louvres, with 1 coat of flat black metal paint to limit of sight line.

3.3.26.7. In unfinished areas leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

3.3.26.8. Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

3.3.26.9. Do not paint over nameplates.

3.3.26.10. Paint behind louvres grilles and diffusers for minimum of 460 mm (18”) or beyond sight line, whichever is greater, to be painted with primer and 1 coat of matt black (non-reflecting) paint.

3.3.26.11. Paint each surface inside of light valances.

3.3.26.12. Paint disconnect switches for fire alarm system and exit light systems in red enamel.

3.3.26.13. Paint or band fire protection piping and sprinkler lines in accordance with mechanical requirements. Keep sprinkler heads free of paint.

3.3.26.14. Paint yellow or band natural gas piping in accordance with mechanical requirements.

3.3.26.15. Back prime and paint face and edges of plywood service panels for telephone and electrical equipment before installation to match adjacent wall surface. Leave equipment in original finish except for touch-up as required and paint conduits, mounting accessories and other unfinished items.

3.4. SITE QUALITY CONTROL

3.4.1. Non-Conforming Work:

3.4.1.1. Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction to Consultant at no cost to Owner. Touch up small affected areas, repaint large affected areas or areas without sufficient DFT of paint. Remove runs, sags of damaged paint by scraper or by sanding prior to application of paint.

3.4.1.2. Following are considered non-conforming qualities:

3.4.1.2.1. Lack of Uniformity:

3.4.1.2.1.1. Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas and foreign materials in paint coatings.

3.4.1.2.1.2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

3.4.1.2.1.3. Damage due to touching before paint is sufficiently dry or any other contributory cause.

3.4.1.2.1.4. Damage due to application on moist surfaces or caused by inadequate protection from weather.

3.4.1.2.1.5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

3.4.1.2.2. Aesthetic Problems: If following are evident under final lighting source (including daylight) for interior surfaces:

3.4.1.2.2.1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1 m (39”).

3.4.1.2.2.2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1 m (39”).

3.4.1.2.2.3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.

3.4.1.2.2.4. When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture and hiding across full surface area.

3.5. CLEANING

3.5.1. Keep waste rags in covered metal drums containing water and remove from building at end of each Day. Remove other combustible rubbish materials and empty paint cans each Day from site and safely dispose of same in accordance with requirements of authorities having jurisdiction.

3.5.2. Clean equipment and dispose of wash water/solvents as well as other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers/strippers in accordance with safety requirements of authorities having jurisdiction.

3.5.3. Clean containers used for storage, mixing and application of materials free of foreign materials and residue.

3.5.4. Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

3.5.5. Clean adjacent surfaces which have been painted, soiled or otherwise marred. Remove spilled, splashed, splattered or sprayed paint as work progresses using means and materials that are not detrimental to affected surfaces.

3.5.6. Remove masking and other protection provided under this Section.

3.5.7. Remove temporary protective wrappings provided by others for protection of work after completion of painting operations unless instructed otherwise.

3.5.8. Painting work will not be considered complete until spatters, drippings, smears and overspray have been cleaned and removed to satisfaction of Consultant.

3.5.9. Make Good any damage to structure building surfaces or furnishings resulting from painting operations at no cost to Owner.

3.5.10. Waste Management:

3.5.10.1. Dispose paint waste in accordance with local regulations.

3.5.10.2. Set aside and protect surplus and uncontaminated finish materials not required by Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 Section Includes:

.1 Use of mechanical systems during construction.

1.2. USE OF SYSTEMS

.1 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under 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

.5 Supply ventilation systems are protected by 60 % filters, inspected daily, changed every 2 weeks or more frequently as required.

.6 Return systems have approved filters over openings, inlets, outlets.

.7 Systems will be:

.1 Operated as per manufacturer's recommendations and instructions.

.2 Operated by Contractor.

.3 Monitored continuously by Contractor.

.8 Warranties and guarantees are not relaxed.

.9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Owner & Consultant.

.10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, 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 approvals for temporary heating ventilation. All miscellaneous equipment.

2 PRODUCTS

1.1 NOT USED

.1 Not used

3 EXECUTION

3.1. NOT USED

.1 Not used

END OF SECTION

1 GENERAL

1.1. GENERAL REQUIREMENTS

.1 Comply with requirements of Division 01

.2 General Requirements and all documents referred to therein.

1.2. DEFINITIONS

.1 Wherever the term "The Consultant" is used in the Division 23 Drawings and Specifications it means CES Engineering Ltd, #709 – 2550 Victoria Park Avenue, Toronto ON, M2J 5A9 (Phone 416-226-4224).

.2 Wherever the term "install" (and tenses of "install") is used in the Division 23 Drawings and Specifications it means install and connect complete.

.3 Wherever the term "supply" is used in the Division 23 Drawings and Specifications it means supply only for installation by other subtrades or under separate contract.

.4 Wherever the terms "Provide" or “Provision of” are used in relationship to equipment, piping, other materials and systems specified for the Work of Division 23, it means "Supply, Install and Connect and make operable to specified performance". Wherever the terms “Provide” or “Provision of” are used in connection with services such as testing, balancing, start-up, preparation of Drawings and commissioning for any part of the Work of Division 23, it means procure, prepare, supervise, take responsibility and pay for these services.

.5 Wherever "Drawings and Specifications" are referred to, it means "the Contract Documents".

.6 Wherever the terms "Authorities" or "Authorities having jurisdiction" are used in the Division 23 Drawings and Specifications it means any and all agencies that enforce the applicable laws, ordinances, rules, regulations or codes of the Place of the Work. Refer to Division 01.

.7 Wherever the term "Work" is used in the Division 23 Drawings and Specifications it means all equipment, permits, materials, labour and Services to provide a complete Mechanical installation as described and detailed on the Drawings and in the Specifications.

.8 Wherever the term "Performance" is used in the Division 23 Drawings and Specifications in relation to specified equipment, it means the specified capacity of that equipment as it applies to provide air, steam or water flow, heating and/or cooling within the specified conditions of operation including air, steam and water pressures, physical space limitations and noise levels.

.9 Wherever the term “Acceptable” is used in the Division 23 Drawings and Specifications it means acceptable to the Consultant.

1.3. REGULATORY REQUIREMENTS

.1 Comply with requirements of all Municipal, Provincial and Federal Bylaws and Ordinances as well as requirements of Utilities such as Ontario Gas Utilization Code, The Ontario Electrical Safety Code. Apply for, obtain, and pay for all permits, fees and service connections for the work and the inspections required by Authorities Having Jurisdiction in the area where the work will take place, including TSSA and ESA. Have the work inspected and certified by PV [Boilers and Pressure Vessels Reg], OE [Operating Engineers Reg.] and FS [Fuel Safety Reg.] branches of TSSA. At the end of the work, the new plant shall be fully TSSA certified by all branches noted herein.

.2 Do not reduce quality of any part of the Work specified and/or shown on the Drawings by following regulatory requirements.

.3 In general, and as applicable, perform all Work of Division 23 to comply with physical and chemical properties, characteristics and performance requirements of recognized associations and agencies as listed herein and in the following:

.1 ACCGH- American Conference of Governmental Industrial Hygienists

.2 AMCA- Air Moving & Conditioning Association

.3 ADC-Air Diffusion Council

.4 ANSI- American National Standards Institute

.5 ARI- Air Conditioning & Refrigeration Institute

.6 ASCII - American Standard Communication Information Interchange

.7 ASHRAE- American Society of Heating, Refrigeration and Air Conditioning Engineers

.8 ASME- American Society of Mechanical Engineers

.9 ASTM- American Society for Testing and Materials

.10 AWWA- American Water Works Association

.11 CGA- Canadian Gas Association

.12 CGSB- Canadian General Standards Board

.13 CIRI- Canadian Industrial Risk Insurers

.14 CSA- Canadian Standards Association

.15 CTI- Cooling Tower Institute

.16 EAI- Electronic Industry Association

.17 FCC-Fire Commissioner of Canada

.18 FM- Factory Mutual

.19 ISA- Instrument Society of America

.20 IAO- Insurers Advisory Organization

.21 MMC-Marsh McLennan Insurance Protection Consultants

.22 MTC- Ministry of Transportation and Communication

.23 NBCC- National Building Code of Canada

.24 NFPA- National Fire Protection Association

.25 OBC-Provincial Ontario Building Code

.26 OFM-Local Fire Codes or Standards Ontario Fire Marshall

.27 MOEE- Ontario Ministry of Environment and Energy

.28 OML- Ministry of Labour and Workmen's Compensation Requirements

.29 OWRA- Ontario Plumbing Code

.30 TSSA- Technical Standards & Safety Authority

.31 UL- Underwriter's Laboratories Inc.

.32 ULC- Underwriter's Laboratories of Canada

1.4. STANDARDS (LATEST REVISIONS)

.1 Provide new materials and equipment of proven design and quality. Provide current models of specified equipment manufactured in Canada or the United States of America, unless specified otherwise with published ratings certified by recognized North American testing and standards agencies.

.2 Provide Canadian made materials and equipment to maximize Canadian content in the Work.

.3 Comply with ASHRAE/IES 90.1 (latest revision) Standards in the supply and installation of all parts of the Work.

.4 Comply with Regulations Amending the Energy Efficiency Regulations P.C. 2004-965 - for the following equipment (latest revision):

.1 Water Chiller - To meet the requirements of CSA C743

.2 Electric Water Heater - To meet the requirements of CSA C191

.3 Gas Fired Water Heater - To meet the requirements of CAN/CSA-P.3

.4 Large Air Conditioner, Heat Pumps and Condensing Units - To meet the requirements of CAN/CSA –C746.

.5 Conform to the best modern practices of workmanship and installation methods and employ only skilled tradesmen working under the direction of fully qualified personnel.

1.5. PERMITS, FEES & INSPECTIONS

.1 Apply for, obtain, and pay for all permits, licences, inspections, examinations and fees required for Work of Division 23. Also submit, if required by the Authorities, information such as heat loss calculations, and other data that may be obtained from the Consultant. Should the Authorities require the information on specific forms, fill in these forms by transcribing thereto the information as provided by the Consultant.

.2 If the municipality is structured as a "single permit jurisdiction", the Contractor will apply, pay for and obtain the municipal building permit. In this case, the Division 23 Subcontractor has no financial obligation for permit application except for permits not covered in the "single permit".

.3 Arrange for inspection of all Work by the Authorities having jurisdiction over the Work. On completion of the Work, present to the Consultant the final unconditional certificate of acceptance of the inspecting Authorities.

.4 Arrange and pay for inspection of all Work by TSSA for Gas, Fuel and Oil Piping Systems. On completion of the Work, present to the Consultant the final unconditional certificate of acceptance of the inspecting Authorities.

.5 In case of conflict, codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the Drawings and Specifications by applying any of the codes referred to herein.

.6 Before starting any work, submit the required number of copies of Drawings and Specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract but notify the Consultant immediately of such changes. Prepare and submit any additional drawings, details or information as may be required.

1.6. CONTRACT DRAWINGS

.1 The Drawings for Mechanical Work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and pipe runs. The Drawings do not intend to show Architectural and Structural details.

.2 Do not scale Drawings. Obtain information involving accurate dimensions from dimensions shown on Architectural and Structural Drawings, and by site measurement.

.3 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (pipes or ducts around beams and columns and other structural elements).

.4 Alter, at no additional cost, the locations of materials and/or equipment as directed that do not necessitate additional material.

.5 Install ceiling mounted or exposed components (e.g. diffusers, sprinkler heads, grilles) in accordance with reflected ceiling drawings or floor plans.

.6 Confirm on the site the exact location and mounting elevation of outlets and fixtures as related to Mechanical and Electrical components and Architectural and Structural details.

1.7. EXAMINATION OF THE PLACE OF THE WORK, SITE AND DOCUMENTATION

.1 Prior to submitting tender, site visit is recommended to carefully examine conditions at the place of the Work which could affect the Work of this Division.

.2 Site visit is recommended to verify that materials and equipment can be delivered to the Place of the Work and that sufficient space and access is available to permit installation thereof in locations shown on the Drawings.

.3 Verify location and elevation of existing services (water, electrical, sanitary, storm sewers, equipment, ductwork and piping) which may affect the Tender and Work of this Division. Repair any damage to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.

.4 Refer also to room finish schedules to determine finished, partially finished and unfinished areas of the building.

1.8. SUBMITTALS

.1 Submittals: in accordance with Division 01 – General Requirements.

.2 The Contractor is required to make submissions as follows:

.1 Prepare a schedule of shop drawings, not later than four weeks after the award of the Contract, indicating drawing submission and equipment delivery dates.

.2 Allow 7 working days for review by our office.

.3 Submit data on originals or good clear photocopies applicable only to equipment or systems being supplied. Do not submit general data covering a range of products. Clearly mark or highlight items being supplied, normal and optional accessories.

.4 Faxed copies of shop drawings will NOT be acceptable.

.5 Shop Drawings shall clearly indicate the identification number used on the drawings or schedules. In addition, the materials and/or equipment being supplied require accurate dimensions, capacity, operating characteristics and performance data as described in the specifications and listed in equipment schedules.

.6 Submit complete packages by system (i.e. all grilles, registers, diffusers) and including all necessary information to allow for complete review of submitted shop drawings and associated system.

.7 Shop Drawings being submitted where the size, capacity or voltage are different from the specified piece of equipment, the specified data and alternate data must be highlighted on the front cover sheet.

.8 “Resubmit” Shop Drawings or Shop Drawings requiring additional information will have to be forwarded or returned to our office in a timely fashion to allow time for review again, along with revised scheduling or delivery date changes as a result of having to provide additional information or resubmission.

.9 Shop Drawings shall be accompanied by a completed copy of the attached “Shop Drawing Submittal Sheet”. The submittal sheet shall be used for stamping by the Contractors and Consultants.

.10 Shop Drawings must bear the stamp and signature of the submitting Sub-Contractor as well as the General Contractor to indicate that the Shop Drawings or Catalogue Cuts are in conformance with all requirements of the drawings, that they have coordinated this equipment with other equipment which is related and/or connected and that they have verified all dimensions to ensure the proper installation of equipment including recommended service space and without interference with the work of other trades. Ensure that mechanical and electrical co-ordination is complete before submitting drawings for review. Incomplete or improperly submitted shop drawings will be rejected.

.11 In addition to project identification, date, etc., the form of stamp used in drawings review will contain the following format:

Drawing: Review ( )

Reviewed As Modified ( )

Revise and Re Submit ( )

Not Reviewed ( )

.12 This stamp to be applied by the Consultant to each and every shop drawing.

.13 This review by the Consultant is for the sole purpose of ascertaining conformance with the design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which to remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of other interfacing Trades as well as compliance with codes and requirements of Authorities.

.14 Samples:

.1 Submit samples representative of material to be delivered to site if requested by Engineer including but not limited to:

.1 Mechanical:

.2 Grilles and diffusers

.3 Access doors including duct access doors

.4 Pipe hangers

.5 Escutcheon plates

.6 Gauges and thermometers

.7 Circuit balance valves

.8 Samples of insulation for pipe, equipment and ductwork

.9 Identification and valve tag samples

.10 Other items as requested by the Consultant

.15 Co-ordination/Installation Drawings:

.1 The Contractor is required to prepare drawings in conjunction with all other trades concerned, showing sleeves and openings for passage through structure and all inserts, equipment bases and supports, and relate these to suitable grid lines and elevation datum.

.2 Prepare co-ordination drawings for all areas where the work of other Divisions 22 and/or 26 could conflict with and/or obstruct the work of other trades and/or other Sections of this Division. Submit drawings for review by the Consultant.

.3 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.

.4 In addition to transmittal letter referred to in Division 01 – General Requirements:

.1 Identify section and paragraph number.

.2 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Division 01 – General Requirements.

.3 Operation and maintenance manual approved by, and final copies deposited with, Engineer before final inspection.

.4 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.

.5 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.

.6 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

.5 23 05 93 – Testing, Adjusting and Balancing for HVAC.

.7 Approvals:

.1 Submit required copies of draft Operation and Maintenance Manual to Departmental Representative and Engineer for approval.

.2 Submit required copies of draft Operation and Maintenance Manual to Owner Representative and Engineer for approval. Submission of individual data will not be accepted.

.3 Make changes as required and re-submit as directed by Owner Representative and Engineer.

.8 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.9 Site records:

.1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required or 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 waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.10 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 Engineer 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.

.11 Submit copies of as-built drawings for inclusion in final TAB report in accordance with Division 01 – General Requirements.

1.9. QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 – General Requirements.

1.10. EQUIPMENT INSTALLATION

.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.

1.11. CLEARANCES

.1 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 or components.

1.12. TRIAL USAGE

.1 General

.1 Commissioning requirements in accordance with Division 01 – General Requirements.

.2 Engineer and Commissioning Agent may use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for testing.

.2 Use of systems during construction

.1 Use of mechanical systems during construction.

.2 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:

.1 Entire system is complete, commissioned, pressure tested, cleaned and 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 cleaned and equipment will not be subjected to dust-producing processes.

.4 There is no possibility of damage.

.5 Supply ventilation systems are protected by 60% filters, inspected daily, changed every 2 weeks or more frequently as required.

.6 Return systems have approved filters over openings, inlets and outlets.

.7 Systems will be:

.8 Operated as per Manufacturer’s recommendations and instructions.

.9 Operated by Contractor.

.10 Monitored continuously by Contractor.

.11 Warranties and Guarantees are not relaxed.

.12 Regular preventive and other Manufacturer's recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative and Engineer.

.13 Refurbish entire system before static completion; clean internally and externally, restore to "as-new" condition and replace filters in air systems.

.3 Filters specified in this Section are over and above those specified in other Sections of this project.

1.13. FIRESTOPPING

.1 All fire stopping work is to be performed by General Contractor.

.2 All Sub-Contractors shall coordinate all fire rated assembly penetrations with General Contractor.

.3 Sub-Contractor shall provide required clearances between outside surface of pipe and inside surface of sleeve, core drilled hole or listed fire rated system.

1.14. TEST

.1 Give 48 hours written notice of date for all tests.

.2 Insulate or conceal work only after testing and approval by Engineer and Commissioning Agent.

.3 Conduct tests in presence of Engineer and Commissioning Agent and local authority having jurisdiction where applicable.

.4 Bear costs including retesting and making good.

.5 Equipment: test as specified in relevant sections and Commissioning Sections.

.6 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.15. INTERPRETATION OF PLANS AND SPECIFICATIONS

.1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans not the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor.

.2 Misinterpretation of the plans or specifications shall not relieve this Contractor of responsibility; final interpretation of details and clauses remains with the Engineer.

.3 Where uncertainty exists in the passing of pipes and location of equipment, the General Contractor and/or project manager shall be consulted before work is started. Where such materials and equipment have been installed so as to cause interference with the inside treatment of the building, they shall be removed and relocated without additional cost to the Owner.

.4 The plans do not necessarily show all valves, duct offsets, access panels, connections, balancing fittings, bases, isolators, flexible connections, drains, etc. and this Contractor shall not avail himself of these obvious omissions, but shall install the work complete in essential details to that it will function properly, can be easily balanced and so that repairs and removal of equipment can easily be made.

.5 Building dimensions shall not be scaled from the Mechanical plans but shall be obtained from on-site dimensions of the building. Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation.

1.16. CO-OPERATION OF CONTRACTORS

.1 This Contractor shall become familiar with the work of other Contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the General Contractor and/or Project Manager and the Engineer before installing the work. Any changes in the work or alterations of the Mechanical Contractor’s schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.

.2 Due to the complexities of many sub-trades and the restrictive space available in this project, it is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or coordination on site.

1.17. SUPERINTENDENCE

.1 Maintain at this job site, at all times, qualified personnel and supporting staff with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.

.2 Supervision personnel and their qualifications are subject to the acceptance of the Consultant.

1.18. SPECIAL CLEANING

.1 Vacuum clean and remove debris from the inside of air handling systems, fans, ducts, coils and terminal units.

.2 Clean exposed surfaces of Mechanical equipment, ductwork and piping. Polish plated work.

.3 Comb all bent fins to proper configuration on all coils in air handling units, fan coil units, entrance heaters and on finned radiation elements.

1.19. COMPLETION

.1 After successful completion of tests and adjustments, remove temporary covers, and strainers, and obstructions to flow. Drain, flush and refill piping systems as often as required until all piping is clear of all debris.

.2 Provide a clean set of filters on each air handling system, fan coil unit, fan powered box and unitary heater.

.3 Provide new filter elements in pump seal filters.

.4 Leave Mechanical work in specified working order.

.5 Provide spare components as specified.

1.20. WARRANTIES

.1 Comply with requirements of Division 01. Provide warranties on specified products, equipment and components as well as on the installation of these items. Include for all costs for cutting and patching, removal of equipment and restoration materials and work and repairs to other equipment affected in performance of warranty work.

.2 Provide warranty certificates, wherever given or required, that are in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.

.3 Warranty periods for all newly installed equipment to start on the date of verification of acceptance issued in writing by the Consultant.

.4 The date of verification of acceptance is independent of Substantial Performance of the Work and may occur after certification of Substantia Performance.

.5 Include verification of acceptance certificates with the maintenance and operating manuals in the appropriate sections.

1.21. INSTRUCTIONS TO OWNER'S STAFF

.1 Refer to Section 01 91 00 - Commissioning.

.2 Instruct the Owner's designated staff on all aspects of the operation of systems and equipment. Advise the Consultant at least one week in advance of the schedules of all instruction sessions.

.3 Obtain the services of Subtrade and Manufacturers' representatives to provide information and instructions on each part of the Mechanical Work and on items of equipment.

.4 Submit to the Consultant immediately following final inspections 3 copies of the "Confirmation of verbal instructions to Owner's operating and maintenance staff" stating for each system or item of equipment:

.1 Date and time instructions commenced for each system.

.2 Duration (hours) instructions were given for each system.

.3 Names of Owner's staff receiving instructions.

.4 Other parties present (Manufacturer's representative, consultants, etc.).

.5 Signatures of each of the Owner's staff in attendance.

1.22. DOCUMENTATION AND SYSTEMS ACCEPTANCE

.1 Comply with requirements of Division 01.

.2 Provide the following on substantial performance of the work:

.1 One set of valve charts set in glazed frames mounted on the project as directed by the Consultant.

.2 Air balancing report. The Work of Division 23 will not be considered totally performed until acceptance by the Consultant of the air balancing report.

.3 As constructed drawings including temperature control drawings.

.4 Three copies of manuals assembled in three ring binders with index tabs, each containing:

.1 This Subcontractor's name, address and telephone/fax numbers

.2 Suppliers and Subtrades names and telephone numbers

.3 Equipment data sheets (dimensions, capacities, electrical characteristics)

.4 Maintenance, operating and lubricating instructions for each item of equipment

.5 Wiring diagrams for each item of equipment

.6 A complete set of checked shop drawings for all equipment provided by this Division.

.7 Certificates for:

.1 Equipment Room AC units start up

.2 Control and Building Automation Systems commissioning

.8 Piping pressure tests (domestic water, fire protection heating/cooling piping) certifying system tested, pressure held, time of test and date and certification by the Consultant and commissioning agent

.9 Refrigerant piping pressure tests

1.23. CASH ALLOWANCES

.1 Cash allowance(s) is (are) listed in Division 01.

1.24. MUNICIPAL AND UTILITY SERVICES

.1 Coordinate, arrange, and pay for all required municipal service and utility connections water, natural gas and sewers (storm and sanitary) as shown on the Drawings, complete with all required metering. Install all metering equipment as well as service connections in accordance with municipal and utility requirements. Pay for all inspection fees arising out of the installation of these services.

1.25. ERRORS AND OMISSIONS

.1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.

.2 Should this Contractor discover errors or discrepancies in the plans or specification, he shall refer the matter to the Engineer for change or clarification and shall not proceed with that portion of the work until advised by the Engineer to do so.

1.26. MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 – General Requirements and as follows:

.1 One glass for each gauge glass.

.2 One set of packing for each pump.

.3 One casing joint gasket for each size pump.

.4 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 Division 01 – General Requirements.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.27. DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 General Requirements.

.2 Store and handle materials in accordance with Construction Plan and Manufacturer’s written instructions.

1.28. PRODUCT STANDARDS AND ALTERNATIVES

.1 Provide new material and equipment as specified and to acceptance of the Consultant.

.2 Equipment requiring greater than specified energy requirements and greater installation and service space requirements will not be accepted.

.3 All electrically operated equipment and electrical materials to bear the label of approval of CSA or be so stamped or have special approval of the Authorities. All material, wiring and devices to conform to the Canadian Electrical Code for the purpose for which they are to be used. All electrical equipment to be designed and manufactured in accordance with applicable CSA and IEEE specifications.

1.29. COMMISSIONING REQUIREMENTS

.1 All sub-contractors shall assist, to the extent required, the Commissioning Agent in the Commissioning process in accordance with Division 01 Sections:

.1 Section 01 91 00 – Commissioning

.2 Appendix B – Commissioning Plan

1.30. SPECIFIC CONDITIONS - HVAC

.1 The specific requirements of the mechanical and electrical works, Division 01, apply to this section.

.2 The following sections are included in the scope of the HVAC work and complement each other to form a whole:

.1	23 01 05	Use of HVAC Systems During Construction
.2	23 05 00	Common Work Results for HVAC
.3	23 05 13	Common Motor Requirements for HVAC Equipment
.4	23 05 17	Pipe Welding
.5	23 05 19.13	Thermometers and Pressure Gauges- Piping Systems
.6	23 05 29	Hangers and Supporters for HVAC Piping and Equipment
.7	23 05 48	Vibration Controls for HVAC
.8	23 05 53	Identification for HVAC Piping and Equipment
.9	23 05 93	Testing, Adjusting and Balancing for HVAC
.10	23 07 13	Mechanical Insulation
.11	23 08 02	Cleaning and Start Up of Mechanical Piping Systems
.12	23 08 10	Commissioning of Mechanical Systems
.13	23 11 23	Facility Natural- Gas Piping
.14	23 21 13	Hydronic Piping and Valves
.15	23 21 16	Hydronic Piping Specialties
.16	23 21 24	Hydronic Pumps
.17	23 25 00	HVAC Water Treatment
.18	23 30 00	HVAC Air Distribution
.19	23 33 00	Duct System Dampers and Accessories
.20	23 36 00	Single Duct Terminal Units
.21	23 37 00	Air Outlets and Inlets
.22	23 37 13	Diffusers, Registers and Grilles

.23 23 73 00.16 Mini Make Up Air Unit

.24 23 74 00 Packaged Outdoor Air Units

.25 25 00 01 Integrated Automation General Requirement

.3 Scope of work

.1 Work included:

.1 The work includes, in general, labor, supply, and installation of all materials and equipment necessary for ventilation – air conditioning work indicated on the drawings and in the specification.

.4 Special connections and related work

.1 See Division 01.

.2 Part of this section's work:

.1 The complete ventilation connections of the various devices indicated on the drawings and/or specifications, whether these devices are part of this section or not. The dimensions of the ventilation ducts to the devices shown in the drawings are approximate and should be verified with the other involved sections before the pipes are manufactured.

.2 The directives, the supervision, and the responsibility for the installation of the various devices provided by this section, installed by another section.

.3 The welded or screwed connections for the ventilation devices and ducts prepared to receive the drain pipes.

.4 The openings and the access doors required for the control devices and the other instruments. The sealing of the pipes passing through the ventilation units.

.5 Documents to provide

.1 Provide the following documents:

.1 The certificates of approval from the concerned authorities.

.2 Shop drawings, device drawings, and erection drawings.

.3 A list of duct identification legends.

.4 Copies of the instruction manuals for the equipment operation and maintenance.

.5 The drawings, kept up to date.

.6 A list indicating for each electric motor: the current in amperes at zero load and at normal load, the capacity of the heater installed in the starter, and the value of the maximum current in amperes inscribed on the motor plate.

.2 A full report of the results requested in the article "VENTILATION SYSTEMS' TAB REPORT" from the section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.6 Submissions – prices to provide

.1 Global price:

.1 Provide with the submission, a global inclusive price covering all the "VENTILATION - AIR CONDITIONING" work.

.2 Declared price:

.1 Also provide the prices declared as included in the overall price for the following work:

.1 Controls

.2 Acoustics and vibrations

.3 Thermal insulation

.7 Submissions - Other information:

.1 All work described in Section 23 05 93 - Testing, Adjusting and Balancing or HVAC should be performed by a company member of the NEBB (National Environmental Balancing Bureau). Indicate the name of the selected specialized company.

1.31. ELECTRICAL CONNECTION

.1 Each relevant mechanical section must provide and install the motors, the thermostats, the controllers, and the other devices specific to their own specialty shown on the drawings and/or requested in the specification.

.2 Unless otherwise indicated, each relevant mechanical section must provide starters and the transformers relating to their specialty. These starters and transformers are installed and connected by Division 26.

.3 According to the indications on the diagrams and the drawings, Division 25 or Division 26 must provide and install conduits, cables, and boxes with complete connections for all mechanical devices, under the supervision of the Division that provided the device.

.4 However, each relevant mechanical section is solely responsible for the operation of their own equipment. They must check all the electrical control sequences and the protection of each device by checking all the overload relay.

.5 Each relevant mechanical section is solely responsible for the selection of the overload relays.

.6 All electrical connections must comply with the electrical specification requirements.

2 PRODUCT

2.1. NOT USED

.1 Not Used.

3 EXECUTION

3.1. PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.2. CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3. FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Division 01 – General Requirements and submit report as described in PART 1 – SUBMITTALS.

.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 PART 1 – SUBMITTALS AND AS SPECIFIED RESPECTIVE SECTIONS.

.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.

3.4. PROTECTION

.1 Protect equipment and systems openings from dirt, dust and other foreign materials with materials appropriate to system.

3.5. INSTALLATION

.1 Install equipment, ductwork, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the acceptance of the Consultant. Install ducts and pipes parallel and perpendicular to building planes. Install piping and ductwork concealed in chases, behind furring, or above ceiling. Install exposed systems grouped to present a neat appearance. Comply with manufacturer's installation instructions.

.2 Install gauges and thermometers to permit easy observance from floor level.

.3 Install all equipment and apparatus with adequate space allowance for wiring, maintenance, adjustment and eventual replacement.

.4 Install control devices to guarantee proper sensing. Shield elements from direct radiation and avoid placing them behind obstructions.

.5 Include in the Work all requirements of Manufacturers shown on shop drawings.

.6 Install all ceiling mounted components (Diffusers, Grilles,) in accordance with reflected ceiling Drawings.

.7 Leave space clear and install all work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or materials supplied by other trades. Verify spaces in which work is to be installed. Install pipe and ductwork runs to maintain maximum headroom and clearances and to conserve space in shaft and ceiling spaces.

.8 Confirm on the site the exact location of equipment and fixtures. Confirm location of equipment supplied by other trades and mechanical requirements thereof.

3.6. EQUIPMENT CONNECTIONS

.1 Provide flexible connectors on supply and return piping connections on all based mounted pumps.

3.7. DRAINS

.1 Pipe all discharge from relief valves and drains from equipment, outside air plenum/ louvre to nearest floor drain or suitable receptacle.

.2 Provide 20mm ball valves with hose ends, caps and chains at strainers, all piping system low points, pumps, coils and at each piece of equipment.

.3 Provide deep seal traps (150mm trap seal) on all air handling equipment condensate drains and on floor drains located within air handling unit plenums. Provide trap seal primers on all floor drain traps and gang traps.

3.8. REFRIGERANT PIPING SYSTEM INSTALLATION

.1 Install all piping in accordance with the best practices of the trade.

.2 The piping shown on the drawings is diagrammatic for clearness in indicating the general run and connections and may or may not be, in all instances, shown in its true position. Take responsibility for the proper erection of systems of piping in every respect suitable for the work intended and as described herein.

.3 Keep plugged or capped all openings in pipe or fittings during installation.

.4 Install piping to avoid any interference with the installation or removal of equipment, other piping and ducts.

.5 Install all valves, strainers and specialities to permit easy operation and access. On horizontal piping, install valves in an upright position. Where there are space constraints mount valves at a 45 deg. off vertical maximum. Install strainers to provide easy strainer basket removal.

.6 Install systems to provide thorough drainage and air elimination.

.7 During welding or soldering procedures, provide a fire retardant cloth, mat or blanket to protect the structure, and adequate fire protection equipment at all locations where work is being done. Close off shaft or confined areas with a fire retardant mat or cloth to prevent sparks or pieces of hot metal from falling down the shaft or area way.

.8 Provide long turn pipe fittings having not less than pipe wall thickness.

.9 Provide line size tees. Where branch lines are more than two sizes smaller than the main, weldolets may be used.

.10 Where it is necessary to offset piping to avoid obstructions, use 45 degree rather than 90 degree elbows.

.11 Provide suitable cleanouts on every other change in direction and slope all condensate drip drains.

.12 Install all piping requiring insulation with sufficient clearance to apply, seal and finish the insulation.

.13 Provide sufficient space between piping to install valves arranged in straight rows or equally spaced steps. Valve wheels, handles and operators to be easily accessible and operable.

.14 Do not suspend any equipment, piping, ducting or any other mechanical components from formed hollow steel decking.

3.9. CONTROL COMPONENTS

.1 Install devices required by the Section 25 05 01 sub contractor such as flow switches, valves and separable wells for temperature controllers and sensors.

3.10. DIRT ACCUMULATION IN CONTROL VALVES

.1 Remove any dirt accumulated under seats of automatic control valves during the first year's operation. Replace damaged valve parts at no additional cost to the Owner.

3.11. FIELD WELDING

.1 Only persons holding current welding certificates for the applications required for the Work to be permitted to do any welding. Perform all welding to Standards specified by Authorities. Do not weld to structural members of the building.

3.12. PROTECTION

.1 Cover openings in equipment and cover equipment where damage may occur from weather. Cover temporary openings in ducts and pipes with polyethylene sheets, until final connection is made. Cover all items cast into concrete floors or walls such as floor drains and cleanouts prior to pour, with heavy plastic tape or duct tape.

.2 Cover and seal, with polyethylene sheeting, all equipment, coils and motors in place during construction to prevent entry of dust, paint and debris.

3.13. RIGGING OF EQUIPMENT

.1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in the designated area in the building.

.2 Direct this work by qualified personnel normally engaged in rigging, hoisting and handling of equipment.

3.14. CONCRETE

.1 Except as specifically indicated on the Mechanical Drawings or where indicated on the Architectural or Structural Drawings as provided by other Sections, provide all concrete work required for mechanical work (bases, curbs, anchors, thrust blocks, manholes, catch basins) in accordance with requirements indicated in Structural Documents. Provide reinforced concrete housekeeping pads (equipment bases) at least 100 mm high under all floor mounted equipment. Provide 150 mm high bases under equipment with cooling coils to provide sufficient clearance for deep seal condensate traps.

.2 Provide in good time, all inserts, sump frames, anchors etc., required to be built into forming for mechanical services.

3.15. METALS

.1 Steel construction required solely for the work of Mechanical trades and not shown on Architectural or Structural Drawings: Provided by Division 23 to the acceptance of the Consultant. Prepare and submit installation drawings on any steel construction for acceptance of the Consultant. Provide one coat of primer on all steel supports located outdoors.

3.16. CUTTING AND PATCHING

.1 Give timely notice concerning required openings. In work already finished the Contractor will perform all cutting and patching at the expense of Division 23. Obtain the approval of the Consultant before doing any cutting.

.2 Provide all cutting and patching for mechanical services penetrating walls, floors and roofs as shown on the Drawings. Cut only to suit dimensions required and for minimum clearances.

.3 Seal around services passing through cut openings with materials commensurate with the fire rating of the wall, floor or roof. Ensure sealing is weatherproof for openings through exterior walls and roofs. Before sealing, provide prime coat of paint on all repaired surfaces.

3.17. LINTELS

.1 Lintels for openings in masonry to conform to requirements given on structural drawings and as required by laws.

.2 Pay all costs for lintels over openings required solely by the mechanical trades.

3.18. IDENTIFICATION OF EQUIPMENT AND PIPING

.1 Identify all automatic control devices and motor driven equipment with 3mm lamacoid plastic plates with bevelled edges having engraved white letter on black background giving the nature of equipment service and its number, i.e. "UPS Room Exhaust E4", "Equipment Room AC -1" Fix to equipment using sheet metal screws. Also provide:

.1 2mm lettering for motor starters and 75mm lettering for equipment.

.2 Where equipment is locally switched (e.g. Room exhaust fans) provide identification plate at switch.

.2 Co-ordinate with BAS subcontractor and obtain list of automatically operated equipment and provide warning identification on lamacoid plate for each item as follows: "Warning: This equipment may start at any time. Do not service without disconnecting power."

.3 Provide all major valves with brass or plated plastic numbered tags, 18mm diameter with stamped numbers. Secure by brass chains to the valve. Valves adjacent to plumbing fixtures, convectors, unit heaters and entrance heaters need not be tagged. Prepare an approved list detailing the valve location, tag numbers and purpose. Mount one (1) copy of this list in a glazed frame where advised by the Owner and provide additional copies for the manuals.

.4 Identify the new piping as to service and direction of flow using stencils and black lettering behind each access door, in each room, and/or every 12m.

3.19. FLASHING

.1 Flash all mechanical parts passing through or built into an outside wall, roof or a waterproof floor.

.2 Provide copper flashing for sleeves passing through exterior walls or water proof floors.

.3 Provide counter flashing on stacks, ducts and pipes passing through roofs to fit over flashing or curb.

3.20. INSTALLATION OF ROOF MOUNTED EQUIPMENT

.1 Flashing of equipment bases and curbed openings for ductwork or roof mounted fans and flashing of roof drains and plumbing vents is specified in Architectural Documents. Equipment bases and curbs for openings to be supplied and set in place by Division 23.

3.21. INSERTS, SLEEVES AND ESCUTCHEONS

.1 Provide all sleeves required for ductwork, piping and access openings.

.2 Place inserts only in portion of the main structure and not in any finishing material.

.3 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.

.4 Provide the following for pipe sleeves:

.1 Through interior walls, exterior walls above grade, interior nonwaterproof floors: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel.

.2 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, DWV copper or copper sheet extended 100mm above the floor and cut flush with the underside.

.5 Provide the following for ductwork:

.1 Where fire dampers are not required in poured walls; removable wood box out of required size. In block or brick walls; masonry to be built around ducting.

.2 Where fire dampers are required; 18-gauge galvanized steel or heavier sleeves complete with steel angle framing both sides installed in accordance with requirements of Authorities. See also detail drawings.

.3 Through Equipment Room floors, Division 3 subcontractor to provide 100mm high concrete curbs for ductwork and any piping so spaced that sleeving is impractical.

.6 Seal all sleeves as follows:

.1 Through fire rated walls and floors and within mechanical assemblies (ducts): Stop insulation flush with all wall and floor surfaces and seal space between duct or pipe and sleeve with ULC approved and listed fire stopping material as manufactured by Double AD Distributors Ltd. (416) 292 2361 or M. W. McGill and Associates Ltd. “Fire Bloc” (416) 291 8393 or Dow RTV Silicon Foam or “Metacaulk” as distributed by EMCO Ltd. (416) 742-6220.

.2 Through all non-fire-rated walls and floors stop insulation, where applicable, at wall and floor surfaces. Ram pack ULC labelled mineral wool materials around piping and ductwork. Apply an approved caulking compound over the ram packed material on both sides.

.3 Through foundation walls: Use either of the two following methods:

.1 Co operate with the Waterproofing trade and apply an approved caulking compound over ram packed mineral wool on both sides. Over this, on both sides, apply a layer of glassfab tape embedded in two coats of an approved mastic compound.

.2 Provide Link-Seal Model S mechanical seal mechanism with stainless steel bolting, EPDM seal element and composite pressure plates as supplied by Power Plant Supply Company (905) 845-7951. Follow Manufacturer's instructions in all aspects of installation procedure.

.7 Cover sleeves and openings around exposed piping in all finished areas with chrome plated escutcheons. Cover exposed duct sleeves in finished areas with an 18-gauge galvanized steel collar fixed to wall or floor.

3.22. ACCESS PANELS AND DOORS

.1 Install all concealed Mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels and doors. Install systems and components to result in a minimum number of access panels.

.2 Access doors are required in walls, ceilings and ductwork for the following:

.1 Fire dampers and motorized dampers (for inspection, repair and resetting). Provide access doors on both upstream and downstream sides of automatic dampers.

.2 Duct mounted coils (duct access upstream and downstream sides for cleaning).

.3 Fan inlets and outlets (for inspection of impellers and vanes).

.4 At VAV terminal inlets for access to air flow measurement devices and for cleaning and servicing

.5 Unitary heating/ cooling equipment, such as heat pumps and fan coils, in ceiling spaces.

.6 Duct mounted smoke detectors (for inspection of in-duct sensors).

.7 Control valves and temperature control components.

.8 Expansion compensators, guides and anchors.

.3 Indicate access panels on "As built" drawings and note at each location the items (i.e. equipment or valve no.) that access is being provided for.

.4 Supply the Division 9 Subtrade with panels, doors or the frames therefore, complete with all pertinent information for installation.

.5 Prepare detail drawings showing location and type of all access doors in coordination with other trades before proceeding wit installation and submit for review.

.6 Size access doors to provide adequate access and be commensurate with type of structure and architectural finish.

.7 Ensure proper rating of doors in fire separations.

.8 Provide lamacoid labels (white on black), screwed in place, on all access doors and access tiles listing items or equipment which access is being provided for.

3.23. PAINTING

.1 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment before painting. This Division is not required to prime coat or paint ductwork or piping. Except to apply two coats of Densopaste primer to cooling tower piping and steel support structures exposed to outdoors and casings of chilled water and domestic water booster pumps. Also paint built up air unit coil drip trays and paint ductwork internally at grilles.

.2 Co ordinate with Division 1 contractor and provide all required assistance in identifying all piping circuits requiring colour coding in addition to natural gas, fuel oil and fire protection piping.

.3 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.24. EXPOSED WORK

.1 Wherever any mechanical work (ductwork and associated thermal insulation) is exposed in finished areas, coordinate the work with the Consultant prior to installation. If unsatisfactory installation results due to not following this procedure, perform remedial work to the Consultant's acceptance.

.2 For purposes of the foregoing, finished areas do not include parking garages and equipment rooms.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section Includes

.2 Section01 00 10 – General Instructions.

1.2. REFERENCES (LATEST REVISIONS)

.1 American Society of Heating, Refrigeration and Air- Conditioning Engineers (ASHRAE):

.1 ASHRAE 90.1-13 – Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

2 PRODUCT

2.1. GENERAL

.1 Provide the prescribed motors for the aimed mechanical devices and systems.

.2 T-Frame type motor housing, class B insulation, type with silencer, and special type junction box.

.3 Unless otherwise indicated, squirrel-cage induction type, operating at 208V, three phase, and 60Hz or at 575V, three phase, and 60 Hz. Some motors operate at different voltages, according to their description which is given in each of the respective sections.

.4 1 HP or higher motors, high efficiency type, according to the standards CSAC390-M1985, IEEE 112B, IEC 34-2, or JEC 37.

.5 Some motors must be explosion-proof. See the respective sections.

.6 Some motors must be of a special type, which can withstand high ambient temperatures, such as those installed in boiler rooms, transformer rooms, generator rooms, or other.

.7 All motors, except those that are directly connected, must be installed on sliding rails enabling easy adjustment and connected to their respective devices with V belts. Adjustment on sliding rails should be done with worm screws. The metal frame forming the bottom of the unit and the motor must be built in one piece if the frame is the assembly’s only base. All motors connected to devices with belts must have their axes chosen to firmly support the pulleys and to cross them entirely.

.8 When frequency inverters are used to control the speed of the motors, the motors must be of the Inverter-Duty type, class F insulation, compliant with NEMA MG1-1993, part 31.

.9 Replace, at no cost to the owner, all excessively noisy or vibrating motors.

.10 Motors shall be squirrel-cage induction motors, built to CEMA and NEMA motor and generator standards.

.11 Three phase motors shall be minimum CEMA Design B; Class B insulated for maximum 40°C (104°F) ambient.

.12 Motors 44.7kW (60 HP) and over shall be inherent overheat protection, consisting of thermistors embedded in each phase of the stator winding and wired to the motor conduit box.

.13 Motors 0.75kW (1 HP) to 373kW (500 HP) shall be Premium Efficiency Motors, and equal or exceed motor efficiency levels as tested to CSA- C390-M and as noted in Table 10.4.1.A(a) of SB-10 in the OBC.

.14 Motors to be approved under Ontario Electrical Safety Code.

.15 Provide explosion-proof motors in locations subject to explosive or flammable environments and as required by code.

.16 Motors driven by Variable Frequency Drives (VFD's) shall be NEMA 31 design, have class F insulation, and be rated for inverter duty.

.17 Motors driven by Variable Frequency Drives (VFD's) shall be provided with stray current corrosion protection.

.18 Motor enclosures shall be as follows:

.1 If protected from the weather and entraining moisture, use open drip-proof, service factor 1.15.

.2 Motors located in air streams shall be selected to operate satisfactory at maximum temperature and moisture levels of surrounding air. Use drip- proof motors with encapsulated windings and weatherproof terminal box.

.3 For all other locations, use totally enclosed, service factor 1.0.

.19 Motors larger than 7.5 kW (10HP) shall be laser aligned.

2.2. CHARACTERISTICS

.1 Comply with the following characteristics:

Description	Power (HP) 0 to 7½	Power (HP) 10 to 15	Power (HP) 20 or more
Regular "drip proof" (open engine protected)	Yes	Yes	Yes
Service factor	1.15	1.15	1.15
Possible overheating	90°C	90°C	90°C
Thermistor type thermal protection on each winding			Yes
Multiple groove pulley for V-belt and variable diameter	Yes		
Multiple groove pulley for V-belt and fixed diameter		Yes	Yes
Grease lubricating ball and/or roller bearings		Yes	Yes
Permanently lubricated ball bearings	Yes		

.1 For axial fans with motors placed in the air flow, the totally enclosed and cooled by the outside airflow type of motor (TEAO) with a minimum service factor of 1.0 can be used.

.2 For axial fans with motors placed in the air flow, the totally enclosed and cooled by the outside airflow type of motor (TEAO) with a minimum service factor of 1.0 can be used.

.3 The manufacturer must provide terminals with identified connections. The motor’s terminal box must be of an appropriate size and have a double compartment, without knockouts (knockouts will be made on-site by Electrical

2.3. SINGLE SPEED MOTORS

.1 Single coil and normal torque motors. Unless otherwise indicated, the motors with six leads for star and triangle connections are prohibited when used with starters other than star-delta.

2.4. TWO-SPEED MOTORS

.1 Unless otherwise indicated, motors with star connections and variable torque.

.1 1800 and 1200 rpm: separate windings type.

.2 1800 rpm and 900: consequent poles.

2.5. BELT DRIVES

.1 Reinforced belts must be installed in the drive pulley. The multiple belts must be provided and installed by matched sets.

.2 The pulleys must be in cast iron or steel and be fixed on the shafts by means of removable keys, unless otherwise indicated.

.3 Motors under 10HP: standard drive pulleys with pitch diameter adjustable in a range of plus or minus 10%. Use the intermediate position when setting the prescribed speed.

.4 10 HP and higher motors: unless otherwise indicated, fixed pitch diameter pulleys, with split taper bushing and keyway. Provide pulleys of suitable dimensions, suitable to the system balancing characteristics.

.5 The required dimensions of the pulleys will be determined during commissioning.

.6 Transmission design features: at least 1.5 times the nominal values stated on the motor nameplate. On the drive motor shafts, the cantilevered loads must stay below the manufacturer's calculation limits.

.7 The mounting plates on rails must allow adjustments along the axis.

2.6. BELT DRIVES GUARDS

.1 Provide guards for the unprotected transmissions.

.2 Belt drive guards:

.1 Expanded metal grating, welded to a steel frame.

.2 Sheet metal top and bottom, at least 1.2 mm thick.

.3 Holes 38 mm in diameter on the two axes of the shaft, for the installation of a tachometer.

.4 Removable for maintenance.

.3 The lubrication of the equipment and the use of test instruments must be possible even when the guards are in place.

.4 The belt guards must permit the displacement of the motors for the tension adjustments.

.1 U-shaped components made of galvanized mild steel, at least 1.6 mm thick.

.2 Securely fastened in place.

.3 Removable for maintenance.

.5 Guards for unprotected fan air inlets and outlets:

.1 Wire rod or expanded metal gratings, galvanized, 19 mm mesh.

.2 Net free area of at least 80% of the fan openings' area.

.3 Securely fastened in place.

.4 Removable for maintenance.

2.7. MANUFACTURER LIST

.1 Comply with article "MANUFACTURER LIST" from Section 01 00 10 – General Instructions.

.2 List of manufacturers, this Section 23 05 13 - Common Motor Requirements for HVAC Equipment:

.1 Motors:

.1 Baldor

.2 Canadian General Electric

.3 Canadian Westinghouse

.4 Leeson

.5 Magnetek

.6 Marathon

.7 Reliance

.8 Tamper

.9 Toshiba

2.8. MOTOR CONTROL CENTRES

.1 Provide motor control centres in mechanical rooms to house multiple motor starters and associated controls, interlocks and pilot lights. Provide MCC's in accordance with CSA, ESA and Ontario Electrical Safety Code.

.2 Control centres shall consist of standard sections to house the equipment contained, all joined together to form a rigid free standing, completely dead front drip tight enclosed assembly. Arrange all units for front access only

.3 Wire all control units for, Type "B" construction with all wiring between starters and assemblies, terminal boards for each starter and all control wiring and load power connections to terminal boards

2.9. MOTOR STARTERS

.1 Provide combination type with non-fused disconnect switch for individual motor starters where overcurrent protection has been provided at motor control centre or distribution source. Provide starters in accordance with CSA, ESA and Ontario Electrical Safety Code.

.2 Provide combination type with fusible disconnect switches for grouped motor starters supplied from a common feeder or splitter. Include all interconnection power wiring

.3 Mount motor control centres on 100mm high concrete bases

.4 Provide watertight connections for all services entering the top of motor control centres

3 EXECUTION

3.1. MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with the requirements, the recommendations, and the manufacturer's written specifications, including product technical bulletins, instructions for product handling, storage, and installation, and data sheet indications.

3.2. INSTALLATION

.1 Fix the devices and the components securely into place.

.2 The appliances and the components must be removable for maintenance and they must be easy to put back and fix into place.

3.3. MOTOR START-UP

.1 Before operating the engine for the first time, the Electrical Division must:

.1 Ensure the presence of the section that provided the engine.

.2 Check the motor's direction of rotation. If the rotation is wrong, see to the corrections and the new connections on the motor and not in the starter, in order to respect the wiring's color coding.

.3 Ensure the main shaft's free movement for all pumps with mechanical joints before starting the motor.

.4 Check the overload protection and the overcurrent protection to ensure that they are adequate.

.5 Check the insulation at the "megger".

.6 Measure the voltage of the electric circuit powering the motor.

.7 Check the voltage (volt) and the current (ampere) of each motor at the start-up and normal operation on each phase.

.8 Check the operation of the motor control centers and the switches.

.2 Ensure the presence of the manufacturer of the engine and/or the device.

.3 The motors' manufacturers must provide the start-up curves of the motor.

.4 After testing and balancing is complete, all variable pitch sheaves shall be replaced with fixed sheaves to match belt groove of driven device.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 23 05 00 Common Work Results

.2 Section 23 05 05 Installation of Pipework

1.2. REFERENCES (LATEST REVISIONS)

.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 Boiler and Pressure Vessel Code:

.1 BPVC Section I: Power Boilers.

.2 BPVC Section V: Nondestructive Examination.

.3 BPVC 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 C1.1M/C1.1, Recommended Practices for Resistance Welding.

.2 AWS Z49.1, Safety in Welding, Cutting and Allied Process.

.3 AWS W1, Welding Inspection Handbook.

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2, Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1, Certification of Welding Inspection Organizations.

.6 CSA W178.2, Certification of Welding Inspectors.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC].

1.4. QUALITY ASSURANCE

.1 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 Submit welder's qualifications to Consultant.

.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.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.5. DELIVERY, STORAGE AND HANDLING UNITS

.1 Deliver, store and handle in accordance with Section 23 05 00 Common Work Results.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.1. ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

3 EXECUTION

3.1. APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2. QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1.

3.3. 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.

.4 Ensure that pipe welding is done by a welder holding a certificate from the Department of Labour for the class of piping to be welded

.5 When welding or cutting with a torch, take every precaution to prevent fire. Ensure that welding or torch cutting operators have a fully charged 4.5kg (10 lb.) carbon dioxide fire extinguisher with them, when welding or cutting in building, or tunnels. Protect wooden structures with asbestos blanket

3.4. INSPECTION AND TESTS- GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Consultant before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Consultant.

.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.

3.5. SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Consultant.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 10 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by Consultant of total of up to 10% of welds, selected at random by Consultant by radiographic tests.

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 1,000 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 tests.

3.7. REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense

3.8. CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 23 05 00 Common Work Requirements.

1.2. REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100- [01], Pressure Gauges and Gauge Attachments.

.2 ASME B40.200- [01], Thermometers, Direct Reading and Remote Reading ANSI/ASME Boiler and Pressure Vessel Code- [2007]:

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-14.4-[M88], Thermometers, Liquid-in-Glass, Self- Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-[M88], Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC].

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Syphons.

.5 Wells.

1.4. HEALTH AND SAFETY

.1 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.

1.5. WASTE MANAGMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal]

.2 Collect, separate and place in designated containers for reuse and recycling paper, plastic, polystyrene, corrugated cardboard packaging, Steel, Metal, Plastic 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 from children.

2 PRODUCTS

2.1. GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges: as indicated.

2.2. DIRECT READING THERMOMETERS:

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4 and ASME B40.200.

2.3. REMOTE READING THERMOMETERS

.1 100]mm diameter mercury-free, liquid filled, activated dial type: to CAN/CGSB-14.5 and ASME B40.200. 2% accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass case for wall mounting.

2.4. THERMOMETERS WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: stainless steel.

2.5. PRESURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

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 indicated] and on inlet and outlet of:

.1 Heat exchangers.

.2 Water heating and cooling coils in air handling units.

.3 Water boilers.

.4 Chiller evaporators and condensers.

.5 Cooling towers.

.6 DHW tanks.

.3 Install wells [as indicated only]for balancing purposes.

.4 Use extensions where thermometers are installed through insulation NPS 2 and smaller: install welding type sockets.

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 all coils in air handling units.

.5 Inlet and outlet of all heat exchangers.

.6 Inlet and outlet of all boilers.

.7 Connection to expansion tank

.8 Inlet and outlet of chiller evaporators and condensers.

.9 Provide one gauge with piping and isolation valves at inlet and outlet of equipment to measure pressures. This eliminates potential calibration errors between inlet and outlet readings.

.10 In other locations [as indicatedInstall gauge cocks for balancing purposes, elsewhere [as indicated].

.2 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. RELATED REQUIREMENTS

.1 Section 23 05 00 Common Work Requirements.

1.2. REFERENCES (LATEST REVISIONS)

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1, Power Piping.

.2 ASTM International

.1 ASTM A 125 Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

.3 MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC].

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

.2 Consultant will make available 1 copy of systems supplier's installation instructions.

1.4. CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 PRODUCTS

2.1. 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 ASME B31.1 or MSS SP 58.

.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 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 in accordance with MSS SP 58.

.6 Design pipe anchors to restrain the movement of pipes in all directions and avoid introduction of undue reaction forces into the structure of the building, to flanges of pumps and equipment, to expansion joints and to the pipe

.2 Performance Requirements:

.1 Design supports, platforms, catwalks, hangers to withstand seismic events as specified Section 23 05 48.

2.2. GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. and ANSI B31.1 (Latest revision)

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

.3 Provide hangers and supports in accordance with applicable codes and standards including ASHRAE, SMACNA, OBC, CSA.

2.3. PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use electro-plating galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 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, or 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, or FM approved to MSS-SP 58 and MSS-SP 69.

.3 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, or FM approved to MSS SP 69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, or FM approved.

.4 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 FM approved to MSS SP 69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies

.2 Steel brackets.

.3 Sway braces for seismic restraint systems.

.6 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.

.7 Pipe attachments: material to MSS SP 58:

.1 Attachments for steel piping: carbon steel black or galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP 69 UL listed or FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis. Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.

.10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated and/or epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.4. RISERS CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.5. INSULLATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 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 SP 69.

2.6. CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A 125, 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.

2.7. 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 complete with factory calibrated travel stops. [Provide certificate of calibration for each hanger].

.4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8. EQUIPMENT SUPPORT

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.9. EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.10. HOUSEKEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50] mm larger than equipment; chamfer pad edges.

.2 Provide concrete housekeeping pads for floor mounted equipment including boilers, chillers, fans, air handling units, tanks, heat exchangers and pumps. Make the minimum size, 100mm high for bases or pads, keyed to the floor slab, extending at least 100mm all around the equipment.

3 EXECUTION

3.1. MANUFACTURER'S

.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, chillers, cooling towers, and 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 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 Provide supports and hangers required for the erection and support of the mechanical work. Construct supports of steel, masonry or concrete as required. Ensure that steel supports in contact with water or high humidity are galvanized members bolted together using cadmium plated bolts, all others primed steel

3.3. HANGER SPACING

.1 Plumbing piping: to Provincial Code and authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 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.

.6 Within [300] mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

.7 Pipework greater than NPS 12: to MSS SP 69.

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.

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.

.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.

3.7. FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.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 PART 1 - ACTION AND INFORMATIONAL 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.

3.8. CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 Vibration isolation materials and components, seismic control measures and their installation.

.2 Related Requirements:

.1 Section 23 05 00 Common Work Requirements.

1.2. REFERENCES (LATEST REVISIONS)

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC)

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC.

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC. Include product characteristics, performance criteria, and limitations.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC.

.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

.2 Provide separate shop drawings for each isolated system. Shop drawings complete with performance and product data.

.3 Provide detailed drawings of seismic control measures for equipment and piping.

2 PRODUCTS

2.1. GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2. ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick;30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3. ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4. SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor 100% relative humidity installations.

.4 Colour code springs.

2.5. SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6. HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.7. ACOUSTIC

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy-duty duck and neoprene isolation material.

2.8. HORIZONTAL THRUST RESTRAIN

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9. STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum

2.10. INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

2.11. ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled.

.2 Lower member: continuous rectangular steel tube or extruded aluminum channel.

.3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.

.4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counter flashing to curb and providing access to springs. Material: neoprene.

.7 Hardware: cadmium plated or galvanized.

3 EXECUTION

3.1. MANUFACTURE'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, installation instructions and datasheet Beam clamps.

3.2. INSTALLATION

.1 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.2 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.3 Where isolation is bolted to floor use vibration isolation rubber washers.

.4 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3. FIELD QUALITY CONTROL

.1 The contractor shall employ structural engineer, specialized in this field and registered with Professional Engineers in Ontario to design and certify seismic control systems for these installations and in accordance with OBC Part 4.

3.4. CLEANING

.1 Proceed 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

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.

.2 Related Requirements

.1 Section 23 05 00 Common Work Results for HVAC

1.2. REFERENCE STANDARDS (LATEST REVISIONS)

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.2 Submittals: in accordance with Section 01 33 00- Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00- Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

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 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.

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] [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 Identification for PSPC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

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 Consultant.

2.4. PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Sprinklers: to NFPA 13.

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 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.3 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.

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.5 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 Other pipes: pressure sensitive [vinyl] [plastic-coated cloth] with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.6 Colours and Legends:

.1 Where not listed, obtain direction from Consultant .

.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
Domestic cold water supply	Green	DOM. CWS
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Engine exhaust	Yellow	ENGINE EXHAUST
Gasoline	Yellow	GASOLINE
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Instrument air	Green	INSTRUMENT AIR

2.6. IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7. VALVES, CONTROLLERS

.1 [Brass] tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8. CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9. LANGUAGE

.1 Identification in English.

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. TIMING

.1 Provide identification only after painting has been completed.

3.3. INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide CSA registration plates as required by respective agency.

3.4. 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.

3.5. 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, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification 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.

3.6. 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 Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7. CLEANING

.1 Proceed 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

1 GENERAL

1.1. GENERAL

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this Section.

.2 As soon as possible after award of contract, the testing and balancing agency shall carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices and shall report the results of the evaluation in writing to the Consultant.

.3 The set of drawings examined by the agency shall be returned to the Consultant with the evaluation report, marked-up to indicate locations for duct system test plugs, and any required revision work such as relocation of balancing devices and locations for additional devices.

.4 After careful review of the mechanical work drawings and specifications, the testing and balancing agency shall visit the site at frequent, regular intervals during construction of the mechanical systems to observe routing of services, locations of testing and balancing devices, workmanship, and anything else which will affect testing, adjusting and balancing.

.5 After each site visit, the agency shall report results of the site visit to the Consultant, in writing, with a copy to the Owner, indicating the date and time of the visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing.

.6 Testing, adjusting and balancing work, as specified herein, shall be performed for the following:

.1 New AC system installed in equipment room.

.2 Existing AHU and distribution system serving project specified areas.

.3 Local AC units and exhaust fans.

.7 Test, adjust and balance the complete mechanical systems over the entire operating range of each system in accordance with the most stringent requirements of the AABC (National Standards for total System Balance) or NEBB Procedural standards for Testing Adjusting Balancing of Environmental Systems), as applicable, in order to obtain optimum systems performance.

.8 All mechanical systems to be tested, adjusted and balanced must be maintained in full, normal operation during each day of testing, adjusting and balancing.

.9 Balance all systems with due regard to objectionable noise which shall be a factor when adjusting fan speeds and performing terminal work such as adjusting grille and diffuser air quantities.

.10 Should objectionable noise occur at design conditions, immediately report the problem to the Consultant and submit data, including sound readings, to permit the Consultant to make an accurate assessment of the noise problem.

.11 Check all air handling system mixing plenums for stratification, and where the variation of mixed air temperature across coils is found to be in excess of plus or minus 5% of design requirements, report to the Consultant.

.12 Perform testing, adjusting and balancing to within plus or minus 5% of design values, and make and record measurements using instruments with minimum accuracy of within plus or minus 2% of required values

.13 Wherever possible, lock all balancing devices in place at the proper setting and permanently mark settings on all devices

.14 Leak test ductwork in accordance with the requirements of SMACNA “HVAC Air Duct Leak Test Manual”. Retest corrected ductwork.

1.2. QUALIFICATIONS OF TAB PERSONNEL

.1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Engineer within 90 Days of award of Contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 The testing, adjusting, and balancing operations must be performed in accordance with the requirements of standard governing the qualifications of the company and the staff responsible for the work.

.4 Associated Air Balance Council (AABC) - National Standards for Total System Balance (Latest revision).

.5 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems (Latest revision)

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB, HVAC Systems - Testing, Adjusting and Balancing of (Latest revision).

.7 Recommendations and suggested practices contained in the TAB Standard:

.1 Mandatory.

.8 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.9 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.10 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.11 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 TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

.12 Testing, adjusting and balancing work shall be performed by a specialist company, who is a member of good standing of the NEBB (National Environmental Balancing Bureau).

.13 Testing, adjusting and balancing work shall be performed by an independent testing and balancing agency having successfully completed testing, adjusting and balancing work for a minimum of five (5) projects of similar size and scope during the last five (5) years.

1.3. 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 all other related systems under all normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4. EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5. 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.

1.6. PRE-TAB-REVIEW

.1 Review Contract Documents before Project construction is started and confirm in writing to Consultant adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Consultant in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

1.7. START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere.

1.8. OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.9. START OF TAB

.1 Notify Consultant 7 Days prior to start of TAB.

.2 Start TAB only 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.

.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of all 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 Correct fan rotations.

.3 Control systems end to end inspections

1.10. APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.2 Central Air Systems: plus or minus 5 %.

.3 Central Air Systems: plus or minus 5 %.

1.11. ACCURACY TOLERANCES

.1 Measured values to be accurate to within plus or minus 5 % of actual values.

1.12. INSTRUMENTS

.1 Prior to TAB, submit to Consultant 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 months of TAB. Provide certificate of calibration to Consultant.

1.13. PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Consultant, 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.

1.14. TAB-REPORT

.1 Format to be in accordance with TAB referenced organization standard, using Imperial Units.

.2 To include as-built full system schematics showing results of TAB.

.3 Submit 3 copies of TAB reports for approval.

.4 Prepare and submit when the work is complete, bound, identified copies of a testing and balancing report.

.5 Prepare the report using standard AABC, NEBB or equal forms to indicate all measurements required by the referenced balancing standard.

.6 Include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location and area served) schematic “as-built” diagram indicating all equipment and accessories.

.7 Include report sheets indicating building comfort test readings for all rooms.

1.15. COMPLETION OF TAB

.1 TAB to be considered complete only when final TAB Report received and approved by Consultant.

.2 When the testing, adjusting and balancing report has been received, the Consultant will schedule a site visit or visits for the purpose of verifying balancing results contained in the report.

.3 In addition to spot checking equipment performance, a maximum of 30% of all terminal equipment will be checked.

.4 The testing and balancing agency shall accompany the Consultant during report verification and shall supply all required tools and instruments to take measurements.

.5 Instruments used shall be the same instruments used in performing the testing and balancing work.

.6 If, during the verification procedures, testing and balancing results indicated in the report are found to differ substantially with the results of spot checks, the report will be rejected by the consultant, and testing, adjusting and balancing procedures shall be repeated, and a new report issued for review and verification.

.7 Testing, adjusting and balancing must be complete and accepted by the Consultant prior to application for a Certificate of Substantial Performance of the Work.

.8 Include a copy of the accepted testing and balancing report in each copy of the operating and maintenance instruction manuals.

1.16. SITE VISIT AFTER COMPLETION OF TAB

.1 After completion of testing, adjusting and balancing work and acceptance of the report, make the following follow-up site visits:

.1 once during the first month of building operation;

.2 once during the third month of building operation;

.3 once between the fourth and tenth months in a season opposite to the first or third month visit.

.2 During each visit and accompanied by the Owner's representative, spot rebalance terminal units as required to suit building occupants and eliminate complaints.

.3 Schedule each visit with the Owner. After each follow-up site visit, issue to the Consultant a report indicating any corrective work performed during the visit, all abnormal conditions and complaints encountered, and recommended corrective action.

.4 After each follow-up visit, issue to the Owner (with a copy to the Contractor and Consultant), a report indicating any corrective work performed during the visit, all abnormal conditions and complaints encountered, and recommended corrective action.

2 PRODUCTS

2.1. NOT USED

.1 Not Used.

3 EXECUTION

3.1. VENTILATION SYSTEMS

.1 General:

.1 Perform tests, measurements and adjustments to:

.1 Demonstrate the ventilation systems are airtight.

.2 Adjust fans to obtain the specified air flows.

.3 Establish quantitative performance of all equipment installed under this section.

.4 Adjust quantity of air to terminal equipment.

.5 Check the adjustment of certain control components.

.2 Check installations for compliance with this section's requirements.

.3 For each system, establish, measure, and adjust the air flow required to meet the specified quantities.

.4 Record and present the results in the form of a report.

.5 Before starting TAB, TAB firm must be approved. The firm must be a certified member of the National Environmental Balancing Bureau Ontario Inc. (NEBB).

.6 Before starting TAB, submit an outline of the proposed procedures required to comply with this article and a list of equipment and instruments to be used.

.7 The selected firm must, for the duration of the installation work, carry out regular site visits and submit a report indicating corrective measures required in order to adequately proceed with TAB (minimum one visit per month or more often depending on site conditions).

.8 Take corrective actions submitted by the retained specialized firm.

.9 Supply the equipment and work force required for leak tests.

.10 Perform the leak tests according to the methods recommended by the Associated Air Balance Council and SMACNA (HVAC Air Duct Leakage Test Manual, Third Edition, August 2002).

.11 Once ducts are installed, but before ceilings, walls, and insulation are installed, check the airtightness of all seals and the condition of all ducts.

.12 Hermetically seal each section undergoing a test and temporarily seal all openings. Run the tests, section by section, on each system, according to the convenience of the location and the established procedure.

.2 Leak tests:

.1 Low pressure ducts:

.1 Conduct a 500 Pa static pressure test on the ducts.

.2 Maximum allowable loss:

.1 For each section tested: 0.48 L/s m² from duct walls.

.2 For overall system, the sum of the leakage must not exceed 3% of the fan(s) airflow.

.3 Adjustment precision:

.1 Do TAB to the following tolerances of the design values:

.1 Air flow adjustment:

.1 At terminal equipment: 10% ±

.2 In main ducts: 5% ±

.2 Differential pressure:

.1 Positive pressure zones:

.1 Supply: 0 to +10%

.2 Exhaust and return: 0 to -10%

.3 Negative pressure zones:

.1 Supply: 0 to -10%

.2 Exhaust and return: 0 to +10%

.4 General procedure:

.1 Equipment and system verification:

.1 Once leak tests are performed and results are satisfactory, proceed with TAB of the equipment and systems as follows:

.1 AHU-1 (supply, return, exhaust) with all the associated air distribution system and equipment as shown on the drawing

.2 AC-1 and AC-2 installed in the equipment room (CRAC units) with all the associated air distribution system as shown on the drawing

.3 AC-4 (new unit in the electrical room)

.4 New exhaust fan

.2 Verify:

.1 Voltage and amperage of motors to avoid overload.

.2 Motor and fan rotation.

.3 Differential pressure switch (DPD) operation.
Position of motorized dampers.

.4 Temperature control of chilled water, hot water or glycol with controls contractor.

.5 Any obvious air leaks.

.6 Develop a ventilation system diagram which identifies all devices and equipment that will be used for testing, adjusting and/or balancing flow. Also identify be taken to all locations where measurements will ensure that sufficient connections are provided on the ductwork. Use this identification as a reference in the balancing report. Ensure that there is no short circuiting in the ductwork system.

.7 Air flow at main branches:

.1 Using a Pitot tube, measure flow rate in the main branches.

.2 If required, adjust fan speed to obtain design airflow.

.3 Check motor power and fan speed to ensure that operation is within critical limits.

.4 Adjust balancing dampers at main branches until design airflow has been reached.

.5 Refer to each type of system described in this section.

.8 Minimum outside air:

.1 Adjust static pressure in unit’s mixing plenum to zero or slightly negative, following the requirements of the site conditions, when the return damper is open to its maximum position. Balancing dampers installed before the mixing plenum is used to set the static pressure in the plenum.

.2 Adjust dampers to set the outside air to a maximum of 105% of design requirement.

.3 System adjustment for balancing work:

.1 Adjust dampers for minimum outside air.

.2 Dual-duct system and constant volume multizone; ensure the proper airflow through the cooling coils and maintain it throughout the adjustments.

.4 Terminal equipment adjustments:

.1 Adjust air flow from terminal units up to the fan.

.2 Use balancing dampers at main branches for major adjustments and dampers at terminal units for precise adjustments.

.3 These adjustments may require multiple iterations.

.4 Note: the total air flow adjusted at the terminal units compared to the readings obtained in the ducts may provide an indication of leakage.

.5 When the system is set to the design air flow, at the branches and the outlets, perform the following readings:

.1 Motor amperage.

.2 Differential pressure at the fans (discharge minus inlet).

.3 Differential pressure at all secondary components (upstream minus downstream).

.4 Differential pressure at all system's primary components (air intake, air exhaust, filters, coils, air-mixing plenums, etc.).

.5 Bypass Terminal Units:

.1 General:

.1 A Bypass terminal unit is designed to maintain a constant volume of supply air, while varying the amount of supply air to the control zone in response to a control signal, such as a thermostat. Bypass terminals are often used with air handling equipment that have a direct expansion coil to minimize the risk of coil freeze-up at partial airflow rates.

.2 The Bypass terminal unit maintains a constant volume of conditioned air to the space while bypassing any supply air not required to satisfy space demand. The bypassed air is either directed into the return air plenum, or ducted back to the Air Handling unit.

.2 Balancing Procedure

.1 Open the dampers of all supply outlets on the discharge duct from the terminal unit.

.2 Adjust the room thermostat so that 100% of the air from the terminal unit is delivered to the room.

.3 Adjust the inlet damper of the terminal unit to provide the required total amount of air.

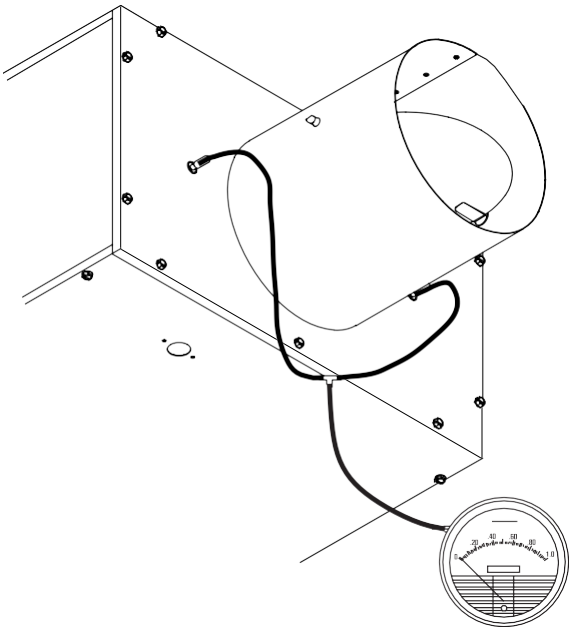
.4 Starting with the outlet the furthest away, adjust the damper of each air outlet to the required air volumes.

.5 Take a static pressure reading using the dual pressure taps on the inlet panel (to obtain an average reading, link the two pressure taps together using two equal lengths of tubing connected by a “T”).

.6 Adjust the room thermostat to provide 100% by-pass air flow (or the minimum air volume to the room, if required).

.7 Position the by-pass sliding damper so that the static pressure reading obtained in step 5 remains unchanged.

.8 Readjust the room thermostat to its operating set point.



.6 Ventilation TAB report:

.1 For each balanced system, the balancing report shall include, as a minimum, the following information:

.1 Dated reports:

.1 On the report cover page, and on all pages of the report, clearly indicate dates when measurements and adjustments, at all stages (preliminary, corrections, revisions) were taken.

.2 Design data:

.1 Airflows.

.2 Supply.

.3 Return.

.4 Exhaust.

.5 Fan static pressure.

.6 Motor power (HP).

.7 Brake horsepower (BHP).

.8 Fan speed (rpm).

.9 Minimum percentage of outside air.

.3 Characteristics of installed equipment:

.1 Manufacturer, model and serial No.

.2 Unit size and dimensions.

.3 Arrangement.

.4 Construction class.

.5 Motor nameplate:

.1 Power

.2 Voltage

.3 Number of Phases

.4 Frequency

.5 FLA

.6 RPM

.4 Tests at main:

.1 Fan speed.

.2 Power readings at the motor terminals (voltage and current on each phase).

.3 Differential pressure across each system component (coils, filters, etc.).

.4 Pressures at suction and discharge of the fan.

.5 Measured air flow.

.6 Fan curve indicating the operating point, based on measurements.

.7 Pressures measured with pressure sensors supplied and installed by the Division 25.

.5 Test at the terminal devices:

.1 Identification of the terminal device by ID number and location.

.2 Type of terminal device:

.1 Manufacturer

.2 Model

.3 Dimension

.4 K-factor

.3 Design airflow and air speed.

.4 Airflow and air speed results.

.5 Adjustment, where applicable, of airflow pattern diffuser.

.6 Additional information:

.1 Fans:

.1 Dimensions and number of belts.

.2 Dimensions of pulleys.

.3 Position of adjustable pulleys.

.4 Full load motor speed.

.5 Overload protection adjustment.

.6 Filter type, initial pressure loss at full flow, final pressure loss for filter replacement.

.7 Air speed readings at coil faces, where possible.

.8 Air flow control device type.

.2 Air distribution system:

.1 Pressure reading at main branches.

.2 Pressure reading in ceiling spaces.

.3 Pressure difference between building interior and exterior when building is operating at minimum and maximum outside air.

.4 List of Pitot tube tests with their results.

.5 List of air flows measured at each grille and diffuser. Indicate the required air flows.

END OF SECTION

1 GENERAL

1.1. APPLICATION

.1 This Section specifies insulation requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.2. SUBMITTALS

.1 **Insulation System Samples:** At least four weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for approval. Mount the samples on a plywood board. Identify each productwith the manufacturer's name and insulation type, and the proposed use of the insulation.When the sample board has been approved, all mechanical insulation work is to conformto the approved sample board.

.2 **Product Data Sheets:** Submit a product data sheet for each insulation system product.

.3 **Removable/Reusable Insulation Covers:** Submit a fabrication drawing for each custommade cover to indicate material and fabrication details, and a 300 mm (12") square sampleof the proposed cover material.

.4 **Lagging Adhesive Colour Samples:** Submit a colour chart for coloured lagging adhesivefor canvas jacketed insulation.

1.3. QUALITY ASSURANCE

.1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, orby an apprentice under direct, daily, on-site supervision of a journeyman mechanic.

.2 Do not apply insulation unless leakage tests have been satisfactorily completed.

.3 Ensure that all surfaces to be insulated are clean and dry.

.4 Ensure that the ambient temperature is minimum 13°C (55°F) for at least one day prior tothe application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.

.5 The company with the sub-contract for mechanical insulation work is to be a member in good standing of the Thermal Insulation Association of Canada.

.6 All insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from the site.

1.4. DEFINITIONS

.1 For the work of this Section:

.1 "concealed" means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces;

.2 "exposed" means exposed to normal view during normal conditions and operations;

.3 "mineral fibre" includes glass fibre, rock wool, and slag wool;

.4 "domestic water" or "potable water" means all piping extended from the buildingMunicipal supply main.

2 PRODUCTS

2.1. FIRE HAZARD RATINGS

.1 Unless otherwise specified, all insulation system materials inside the building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.2. THERMAL PERFORMANCE

.1 .1 Unless otherwise specified, thermal performance of insulation is to meet or exceed the values given in Tables 6.8.2.A, 6.8.2.B, 6.8.3.A and 6.8.3.B of ASHRAE/IES Standard 90.1-2013.

2.3. PIPE INSULATION MATERIALS

.1 **Horizontal Pipe Insulation at Hangers & Supports:** Equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, premoulded, rigid, sectional phenolic foam insulation (of same thickness as adjoininginsulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.

.2 **Flexible Foam Elastomeric:** Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96-90, Procedure B, and all required installation accessories. Acceptable products are:

.1 Armacell AP/Armaflex SS;

.2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.

.3 **Premoulded Mineral Fibre:** Rigid, sectional, sleeve type insulation to ASTM Standard C 547-00, with a factory applied vapour barrier jacket. Acceptable products are:

.1 Johns Manville Inc. "Micro-Lok AP-T Plus";

.2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;

.3 Manson Insulation Inc. "ALLEY K APT";

.4 Owens Corning Fiberglas Pipe Insulation.

.4 **Blanket Mineral Fibre:** Blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m3 (1½ lb./ft.³) density, with a factory applied vapour barrier facing. Acceptable products are:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.5 **Premoulded Weatherproof Jacketed Mineral Fibre:** Knauf Insulation "Redi-Klad 1000"sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.4. EQUIPMENT INSULATION MATERIALS

.1 **Blanket Mineral Fibre:** Blanket type roll form insulation to ASTM Standard C553-00, 24 kg/m3 (1½ lb./ft.³) density, with a factory applied vapour barrier facing. Acceptable products are:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.2 **Semi-Rigid Mineral Fibre Board:** Roll form, moulded insulation to ASTM Standard C1393-00a, with a factory applied vapour barrier facing consisting of laminated aluminumfoil and kraft paper. Acceptable products are:

.1 Knauf Fiber Glass Pipe and Tank Insulation;

.2 Manson Insulation Inc. "AK FLEX";

.3 Johns Manville Inc. Pipe and Tank Insulation “Micro-Flex”;

.4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";

.5 Owens Corning Pipe and Tank Insulation;

.6 Glass-Cell Fabricators Ltd. "R-Flex".

2.5. DUCTWORK SYSTEM INSULATION MATERIALS

.1 **Rigid Mineral Fibre Board:** Preformed board type insulation to ASTM C612-00a, 48 kg/m3 (3.0 lb./ft.³) density, with a factory applied reinforced aluminum foil and kraft paperfacing. Acceptable products are:

.1 Knauf Fiber Glass Insulation Board with FSK facing;

.2 Manson Insulation Inc. "AK BOARD FSK";

.3 Johns Manville Inc. Type 814 "Spin-Glas";

.4 Owens Corning 703.

.2 **Semi-Rigid Mineral Fibre Board:** Roll form insulation to ASTM Standard C1393 00a, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraftpaper facing. Acceptable products are:

.1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";

.2 Glass-Cell Fabricators Ltd. "R-FLEX";

.3 Owens Corning Pipe and Tank Insulation;

.4 Johns Manville Inc. Pipe and Tank Insulation.

.3 **Blanket Mineral Fibre:** Blanket type roll form insulation to ASTM Standard C553-00, 24 kg/m3 (1½ lb./ft.³) density, 40 mm (1½") thick, with a factory applied vapour barrier facing.Acceptable products are:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.4 **Flexible Foam Elastomeric Sheet - Indoor:** Sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A. Acceptable products are:

.1 Armacell "AP/Armaflex SA";

.2 IK Insulation Group "K-Flex Duct Wrap", S2S.

.5 **Flexible Foam Elastomeric Sheet - Outdoor**. Sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of zero in accordance with ASTM C 534, Type II. with 17.5 mils laminated covering, UV resistance. Acceptable products are:

.1 Armacell “ArmaTuff SA” or equivalent.

2.6. INSULATING COATINGS

.1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:

.1 anti-condensation coating, "No Sweat-FX";

.2 thermal insulating coating, "ThermaLite".

2.7. INSULATION FASTENINGS

.1 **Wire:** Minimum #15 gauge galvanized annealed wire.

.2 **Wire Mesh:** Minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1")hexagonal mesh.

.3 **Aluminium Banding:** Equal to ITW Insulation Systems Canada "FABSTRAPS" minimum12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.

.4 **Stainless Steel Banding:** Equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.

.5 **Duct Insulation Fasteners:** Weld-on 2 mm (3/32") diameter zinc coated steel spindles ofsuitable length, complete with minimum 40 mm (1½") square plastic or zinc plated steel self-locking washers.

.6 **Tape Sealant:** Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.

.7 **Adhesive - Mineral Fibre Insulation:** Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, and WHMIS classified as non-hazardous.

.8 **Adhesive – Flexible Elastomeric Insulation:** Armacell "Armaflex" #520 air-drying contact adhesive.

.9 **Lagging Adhesive:** White, brush consistency, ULC listed and labeled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for color tinting, complete with fungicide and washable when dry.

.10 **Sheet Metal Screws:** No. 10 stainless steel sheet metal screws.

2.8. INSULATION JACKETS AND FINISHES

.1 **White PVC:** Roll form sheet and fitting covers, minimum 15 mil thick white PVC, 25/50 rated, complete with installation and sealing accessories. Acceptable products are:

.1 Proto Corp. "LoSMOKE";

.2 The Sure-Fit System "SMOKE-LESS 25/50";

.3 Johns Manville Inc. "Zeston" 300.

.2 **Rigid Aluminium:** Where the ductwork/pipework are exposed to outside, the insulation shall have rigid aluminum jackets. Equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209 and ASTM C1729, factory cut to size and complete with polysurlyn moisture barrier and continuous modifiedPittsburgh Z-Lock, and "Fabstraps" and butt straps with weatherproof the end to end joints.Fittings are to be two-piece epoxy coated pressed aluminum with weather locking edges.

.3 **Stainless Steel:** Equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel to ASTM A240, factory cut to size and completewith moisture barrier and continuous modified Pittsburgh Z-Lock, and butt straps with "Fabstraps" to cover end to end joints. Fittings are to be two pieces pressed stainless steelwith weather locking edges.

.4 **Adhesive Backed Flexible Aluminium:** MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high- density polyethylene reinforcement, and an embossed aluminum facing.

.5 **Protective Coating - Flexible Foam Elastomeric Insulation:** Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

3 EXECUTION

3.1. GENERAL INSULATION APPLICATION REQUIREMENTS

.1 Unless otherwise specified, do not insulate the following:

.1 factory insulated equipment and piping;

.2 heating piping within radiation unit enclosures, including blank filler sections ofenclosures;

.3 heating piping in soffits and/or overhang spaces and connected to bare elementradiation in the spaces;

.4 branch potable water piping located under counters to serve counter mountedplumbing fixtures and fittings, except barrier-free lavatories;

.5 exposed chrome plated potable water angle supplies from concealed piping toplumbing fixtures and fittings, except barrier-free lavatories;

.6 heated liquid system pump casings, valves, strainers and similar accessories;

.7 heating system expansion tanks;

.8 manufactured expansion joints and flexible connections;

.9 acoustically lined ductwork and/or equipment;

.10 flexible branch ductwork from sheet metal ducts to grilles or diffusers;

.11 piping unions, except for unions in "cold" category piping.

.2 Install insulation directly over pipes and ducts and not over hangers and supports.

.3 Install piping insulation and jacket continuous through pipe openings and sleeves.

.4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.5 When insulating "cold" piping and equipment, extend insulation up valve bodies and othersuch projections as far as possible, and protect the insulation jacketing from the action ofcondensation at its junction with the metal.

.6 When insulating vertical piping risers 75 mm diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada NationalInsulation Standards, Figure No. 9.

.7 Where existing insulation work is damaged as a result of a new mechanical work, repair the damaged insulation work to new work standards.

.8 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions,etc., neatly cover the exposed end of the insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.

.9 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

.10 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required,create a neat, properly sized hole in the insulation and provide a suitable grommet in theopening.

3.2. INSULATION FOR HORIZONTAL PIPE AT HANGERS AND SUPPORTS

.1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, andunless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply the insulation sections to the piping installers for installation as the pipe is erected.

.2 For 100 mm (4") diameter and larger heating system piping where roller type hangers andsupports are provided, a steel saddle will be tack welded to the pipe at each roller hangeror support location. Pack saddle voids with loose mineral wool insulation.

3.3. PIPE INSULATION REQUIREMENTS - MINERAL FIBRE

.1 Insulate the following pipe inside the building and above ground with mineral fibreinsulation of the thickness indicated:

.1 domestic cold water piping to and including 100 mm (4") dia. – 25 mm (1") thick;

.2 domestic cold water piping larger than 100 mm (4") dia. – 40 mm (1½") thick;

.3 domestic hot water piping, to and including 40 mm (1½") dia. – 25 mm (1") thick;

.4 domestic hot water piping, larger than 40 mm (1½") dia. – 40 mm (1½");

.5 tempered domestic water piping, supply and return, to and including 40 mm (1½")dia. – 25 mm (1") thick;

.6 tempered domestic water piping, supply and return, larger than 40 mm (1½") dia.

.7 – 50 mm (2") thick;

.8 hot water heating piping, supply and return, to 40 mm (1½") dia. – 40 mm (1½")thick;

.9 hot water heating piping, supply and return, 40 mm (1½") dia. and larger – 50 mm(2") thick;

.10 boiler feedwater piping complete – 25 mm (1") thick;

.11 boiler blowdown piping complete – 40 mm (1½") thick;

.12 all piping as above located inside building in unheated areas and indicated to betraced with electric heating cable – minimum 50 mm (2") thick;

.2 **Piping:** Ensure that the overlap flap of the sectional insulation jacket is secured tightly inplace. Cover section to section butt joints with tape sealant.

.3 **Fittings:** Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulationto a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.

.4 **"Cold" Piping Unions, Valves, Strainers, Etc.:** Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping such as domestic water or chilled water piping with cut and tightly fitted segments of sectional pipeinsulation with all joints covered with tape sealant, or, alternatively, wrap the piping union,valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for "Fittings"above.

.5 **Flanges and Mechanical Couplings:** Terminate sectional insulation approximately 50 mm (2") from the flange or coupling on each side of the flange or coupling. Cover the flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulationwide enough to butt tightly to the ends of the adjacent sectional insulation. Secure the blanket insulation in place and cover with a purpose made purpose made PVC coupling cover.

.6 **Concealed Rough-In Piping at Plumbing Fixtures:** Take special care at concealed water rough-in piping at plumbing fixtures to ensure that the piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieuof 25 mm (1") thick insulation.

3.4. EQUIPMENT INSULATION REQUIREMENTS - BLANKET TYPE MINERAL FIBRE

.1 Insulate the following equipment with mineral fibre blanket type insulation of the thickness indicated:

.1 domestic cold water pump casings – 40 mm (1½") thick;

.2 Unless otherwise noted, wrap the equipment to a thickness and insulating value equal toan equivalent thickness of rigid sectional pipe insulation. Laminate the insulation in placewith a full coverage of adhesive and secure with wire. Apply a jacket of the insulation vapour barrier material secured in place with adhesive or sealant tape.

.3 Lay the fibreglass blanket on radiant ceiling panels after testing is complete.

3.5. EQUIPMENT INSULATION REQUIREMENTS - SEMI-RIGID MINERAL FIBRE

.1 Insulate the following equipment with semi-rigid mineral fibre board insulation of thethickness indicated:

.1 uninsulated domestic hot water storage tank(s) – 40 mm (1½") thick;

.2 flash tanks – 40 mm (1½") thick;

.3 heating main air separator – 40 mm (1½") thick;

.2 Install the insulation as required to fit the shape and contour of the equipment. Secure theinsulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when the insulating cementhas dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.

.3 For "cold" equipment, prime the insulation with suitable sealer and apply a jacket of glassthread reinforced foil and kraft paper vapour barrier jacket material laminated in place witha full coverage of adhesive.

.4 Provide removable and replaceable insulated metal covers for all equipment with removable heads to permit the heads to be removed and replaced without damaging theadjacent insulation work.

3.6. DUCTWORK INSULATION REQUIREMENTS - MINERAL FIBRE

.1 Insulate the following ductwork systems inside the building and above ground with mineralfibre insulation of the thickness indicated:

.1 all outside air intake ductwork, casings and plenums from fresh air intakes to andincluding mixing plenums or sections, or, if mixing plenums or sections are not provided, to the first heating coil, or if both mixing plenums or sections and heatingcoil sections are not provided, and the fresh air is not tempered, then the fresh airductwork system complete – minimum 40 mm (1½") thick as required;

.2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1½") thick flexible blanket as required;

.3 supply air ductwork outward from fans, except for supply ductwork exposed in thearea it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1½") thick flexible blanket as required;

.4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1½") thick flexible blanket as required;

.5 any other ductwork, casings, plenums or sections specified or detailed on the drawings to be insulated – thickness as specified.

.2 Insulation for casings, plenums, and exposed rectangular ductwork is to be rigid board type. Insulation for round ductwork and concealed rectangular ductwork is to be blanket type.

.3 **Exposed Rectangular Ducts and/or Casings:** Liberally apply adhesive to all surfaces ofthe duct and/or casing. Accurately and neatly press the insulation into the adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal all joints with 75 mm (3") wide tapesealant. Additional installation requirements are as follows:

.1 at trapeze hanger locations install insulation between the duct and the hanger;

.2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where the insulation is subject to accidental damage, and secure in place with tape sealant.

.4 **Concealed Rectangular or Oval Ductwork:** Liberally apply adhesive to all surfaces of the duct, and wrap the insulation around the duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal all joints with 75 mm (3") tape sealant. Additional installation requirements are as follows:

.1 at each trapeze type duct hanger provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between the duct and the hanger.

.5 **Exposed & Concealed Round or Oval Ductwork:** Accurately cut sections of insulation to fit tightly and completely around the duct. Liberally apply adhesive to all surfaces of theduct, and wrap the insulation around the duct with a top butt joint and tight section to section butt joints. Seal all joints with tape sealant. At duct hanger locations install the insulation between the duct and hanger. At each hanger location for concealed ductworthwhere flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between the duct and the hanger.

.6 **Common Duct Insulation Requirements:** Insulation application requirements common to all types of rigid ductwork are as follows:

.1 at duct connection flanges insulate the flanges with neatly cut strips of the rigid insulation material secured with adhesive to side surfaces of the flange with a topstrip to cover the exposed edges of the side strips, then butt the flat surface duct insulation up tight to the flange insulation, or, alternatively, increase the insulationthickness to the depth of the flange and cover the top of the flanges with tape sealant;

.2 the installation of fastener pins and washers is to be concurrent with the duct insulation application;

.3 cut insulation fastener pins almost flush to the washer and cover with neatly cut pieces of tape sealant;

.4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;

.5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch all vapour barrier damage by means of tape sealant.

3.7. DUCTWORK INSULATION REQUIREMENTS - FLEXIBLE ELASTOMERIC

.1 Insulate all exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside the building with minimum 40 mm (1½") thick flexible elastomeric sheet insulation as required, applied in two minimum 20 mm (¾") thick layerswith staggered tightly butted joints.

.2 Install with adhesive in strict accordance with the manufacturer’s published instructions toproduce a weather-proof installation. Ensure that sheet metal work joints are sealed watertight prior to applying insulation.

3.8. APPLICATION OF INSULATING COATINGS

.1 Apply, in accordance with the manufacturer’s instruction, insulating coatings to thefollowing bare metal surfaces:

.1 paint all bare metal surfaces clear of "cold" piping and/or equipment insulation fora distance of from 300 mm (12") to 600 mm (24") clear of the pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;

.2 paint all bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.

.2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.9. INSULATION FINISH REQUIREMENTS

.1 **Canvas:** Unless otherwise shown and/or specified, jacket all exposed mineral fibre insulation, and calcium silicate duct insulation work inside the building with canvas secured in place with a full 100% covering coat of lagging adhesive. Accurately cut canvaswith scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatterfrom adjacent uninsulated surfaces.

.2 **White PVC:** Jacket exposed pipe insulation work inside the building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal all joints to produce aneat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

.3 **Rigid Aluminium.** Jacket exposed duct/pipe insulation work outside the building with rigid aluminum jacket, secured in place with a full 100% covering coat of lagging adhesive. Cover tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal all joints to produce aneat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2. REFERENCES (LATEST REVISIONS)

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E 202-00, 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).

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC.

1.4. QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety.

1.5. DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

2 PRODUCTS

2.1. CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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. CLEANING HYDRONIC SYSTEMS

.1 Timing: systems 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 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 used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: 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 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.8 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design 82 degrees C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3. 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 Systems.

.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 for HVAC.

.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 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 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.

3.4. CLEANING

.1 Proceed 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

1 GENERAL

1.1. SUMMARY

.1 The purpose of this section is to specify the Division 20 - 25 contractor's responsibilities in the commissioning process.

.2 An independent firm specializing in building systems commissioning has been retained by the Owner to act as the project Commissioning Authority (CA). This firm will be responsible to manage and administrate the commissioning process on this project.

.3 The list of commissioned equipment and systems is found in Section 01 91 13 Commissioning – General Requirements. Commissioning requires the participation of contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in the same section.

.4 Contractors shall be familiar with all parts of Section 01 91 13 Commissioning – General Requirements, 01 79 00.13 Commissioning – Training, and the Commissioning Plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2. RESPONSIBILITIES

.1 The responsibilities of the Project Manager, Construction manager, Architect, Mechanical and Electrical Consultants/Engineers (A/E), and Commissioning Authority in the commissioning process are provided in Section 01 91 13 Commissioning General Requirements.

.2 This section defines the generally expected division of responsibilities between the trades responsible for delivering Divisions 20 - 25 work in its entirety, together with related work in the overall project. These responsibilities may be adjusted as required by the Contractor.

.3 Mechanical Controls and TAB Contractors:

.1 Construction and Acceptance Phase:

.1 Include the cost of participating in the commissioning process as outlined in the specifications in the total contract price.

.2 In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.

.3 Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.

.4 Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment.

.5 Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.

.1 Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.

.2 In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CA.

.3 The CA may request further documentation necessary for the commissioning process.

.4 This data request may be made prior to normal submittals.

.6 Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.

.7 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as- built drawings for all drawings and final as-builts for contractor- generated coordination drawings.

.8 Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.9 Provide assistance to the CA in preparing the specific functional performance test procedures as specified in Section 01 91 13 and in this section. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.10 Develop a full start-up and initial checkout plan using manufacturer’s start-up procedures and the pre-functional checklists from the CA for all commissioned equipment.

.11 Submit manufacturer’s detailed start-up procedures and the full start-up plan to CA for review and approval prior to startup. Refer to the Commissioning Plan and this section for further details on start-up plan preparation.

.12 Be proactive in seeing that commissioning processes are executed and that the CA have the scheduling information needed to efficiently execute the commissioning process.

.13 During the startup and initial checkout process, execute the mechanically related portions of the pre-functional checklists for all commissioned equipment.

.14 Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.

.15 Address current A/E punch list items before scheduling functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.

.16 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.17 Perform functional performance testing under the direction of the CA for specified equipment in Section 01 91 13.

.18 Assist the CA in interpreting system monitoring data, as necessary.

.19 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, CM and A/E and retest the equipment.

.20 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.21 Provide training of the Owner’s operating staff using expert qualified personnel, as specified.

.22 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.2 Warranty Phase

.1 Execute seasonal, deferred or post occupancy functional performance testing, witnessed by the CA, according to the specifications.

.2 Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

.4 Mechanical Contractor: The responsibilities of the mechanical contractor, during construction and acceptance phases in addition to those listed in 1.2.3 are:

.1 Provide startup for all HVAC equipment, except for the building automation control system.

.2 Assist and cooperate with the TAB contractor:

.1 Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

.2 Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

.3 Install a P/T plug at each water sensor which is an input point to the control system.

.4 List and clearly identify on the as-built drawings the locations of all air-flow stations.

.3 Prepare a preliminary schedule for Division 23 and 25 piping system(s) testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate.

.4 Notify the CM or CA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur.

.5 Be responsible to notify the CM or CA ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction.

.5 Controls Contractor (Division 25): The responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in 1.2.3 are:

.1 Sequences of Operation Submittals

.1 The Controls Contractor’s submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

.1 An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.

.2 All interactions and interlocks with other systems.

.3 Detailed delineation of control between any packaged controls and the building automation system, listing what points the EMCS monitors only and what EMCS points are control points and are adjustable.

.4 Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).

.5 Start-up sequences.

.6 Warm-up mode sequences.

.7 Normal operating mode sequences.

.8 Unoccupied mode sequences.

.9 Shutdown sequences.

.10 Capacity control sequences and equipment staging.

.11 Temperature and pressure control: setbacks, setups, resets, etc.

.12 Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.

.13 Effects of power or equipment failure with all standby component functions.

.14 Sequences for all alarms and emergency shut downs.

.15 Seasonal operational differences and recommendations.

.16 Initial and recommended values for all adjustable settings, set-points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.

.17 Schedules, if known.

.18 To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

.2 Control Drawings Submittal

.1 The control drawings shall have a key to all abbreviations.

.2 The control drawings shall contain graphic schematic depictions of the systems and each component.

.3 The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.

.4 Provide a full points list.

.5 The Controls Contractor shall keep the CA informed of all changes to this list during programming and setup.

.3 As-Built Documentation

.1 An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal and shall include any system tuning and/or sequence of operation modifications established during functional testing.

.4 Required Assistance to TAB: Assist and cooperate with the TAB contractor in the following:

.1 Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB.

.2 Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).

.3 For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CA prior to TAB.

.4 Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

.5 Required Assistance to CA: Assist and cooperate with the CA in the following manner:

.1 Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls contractor in this section.

.2 Assist in the functional testing of all equipment specified in Section 01 91 13 and this section.

.3 Provide two-way radios during the functional testing.

.4 Execute all control system trend logs specified in Division 25.

.6 Written Agenda

.1 The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process in Section 01 91 13 and this section.

.2 At minimum, the plan shall include each type of equipment controlled by the automatic controls.

.7 Checkout Certification

.1 Provide a signed and dated certification to the CA, and CM upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.

.8 Additional Control Points

.1 Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified in Division 25.

.2 List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

.6 TAB Contractor: The duties of the TAB contractor, in addition to those listed in 1.2.3 are:

.1 Submit the outline of the TAB plan and approach for each system and component to the CA, CM and the controls contractor four weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system. The submitted plan will include:

.1 Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.

.2 An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.

.3 All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

.4 Discussion of what notations and markings will be made on the piping drawings during the process.

.5 Copies of the final test report forms to be used.

.6 Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the hydronic side.

.7 List of all water flow, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

.8 Details of how total flow will be determined (pump curves, circuit setter, flow station, ultrasonic, etc.).

.9 The identification and types of measurement instruments to be used and their most recent calibration date.

.10 Specific procedures that will ensure that water side is operating at the lowest possible pressures and provide methods to verify this.

.11 Details of methods for making any specified coil or other system plant capacity measurements.

.12 Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.

.13 Details regarding specified deferred or seasonal TAB work.

.14 Details of any specified false loading of systems to complete TAB work.

.15 Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

.16 Plan for formal progress reports (scope and frequency).

.17 Plan for formal deficiency reports (scope, frequency and distribution).

.2 A running log of events and issues shall be kept by the TAB field technicians.

.1 Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA and CM at least twice a week.

.3 Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

.4 Provide a draft TAB report to the CA within two weeks of completion including a full explanation of the methodology, assumptions and the results in a clear format with designations of all abbreviations.

.5 Provide the CA with any requested data, gathered, but not shown on the draft reports.

.6 Provide a final TAB report for the CA with details, as in the draft.

.7 Conduct functional performance tests and audit checks on the original TAB as specified for TAB in Section 23 05 93.

2 PRODUCTS

2.1. TEST EQUIPMENT

.1 Contractor shall provide all test equipment necessary to fulfill the testing requirements of this section.

.2 Contractors shall submit a list of equipment to be used and copies of latest equipment calibration certificates to the Commissioning Authority and Consultant for approval.

.1 The equipment to be provided shall include, but is not limited to:

.1 pressure measurements: manometers, pressure gauges, digital pressure readers, pressure trending devices;

.2 temperature measurements: thermometers, digital thermometers, thermocouples, temperature trending devices;

.3 rotative speed: tachometer;

.4 sound measurement: electronic sound level meter for acoustic measurement with octave band analysis;

.5 vibration measurement: accelerometer;

.6 electrical measurements: voltmeter, ammeter and wattmeter

.7 Any other equipment specified by the manufacturer to perform required testing and verification.

.3 Refer to Section 01 91 13 for additional requirements

2.2. TEST EQUIPMENT CALIBRATION

.1 All equipment shall be calibrated and carry current certification in accordance with the manufacturer’s instructions.

.2 A copy of test equipment specifications and calibration certificates must be included in a dedicated submittal for each division.

3 EXECUTION

3.1. SUBMITTALS

.1 Contractor shall provide submittal documentation relative to commissioning as required in Part 1 of this section, 01 91 13 Commissioning - General Requirements, and the Commissioning Plan.

.2 The following are required submissions as outlined in this specification. Additional technical submittals shall be provided as requested at the initial commissioning meetings and dependent on the technical scope of the project.

3.2. PRE-STARTUP

.1 Carry out any Factory Acceptance Tests and off-site pre-commissioning as otherwise directed by the technical specifications of Divisions 20 - 25.

3.3. START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

.1 General

.1 The sub-contract trades shall follow the start-up and initial checkout procedures listed in this section, in 01 91 13 and in Divisions 20 - 25.

.2 The Contractor has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents.

.3 The following system start-up procedures are presented as a minimum standard of acceptance to validate the commissioning of the identified systems. Requirements listed in the mechanical consultant's specification sections may differ from the requirements listed below. The most onerous requirements shall be carried by the contractor in all cases.

.2 <u>Phase 1 - System and Equipment Readiness</u>

.1 Before starting up any systems or equipment, provide written verification stating that the specific system or item of equipment is ready for starting and the following conditions have been met:

.1 Copies of all tests and certificates have been submitted to the Consultant and/or CA.

.2 All safety controls have been installed, wired, dry tested, and are fully operational.

.3 The permanent electrical wiring connections have been made to all equipment and that power is available.

.4 Qualified operating personnel are available and ready to operate the equipment.

.5 All systems have been checked and are physically complete and ready to operate, including all wiring and controls.

.6 Correct operation of all equipment and machinery, correct fan rotation, pump rotation, etc. has been confirmed.

.7 All equipment lubrication and pre-start checks have been carried out.

.8 Proper overload protection has been provided for all motors, controls, and control circuits.

.9 All system flushing, chemical cleaning, chemical water treating, chlorinating, charging, fluid operating levels, etc. have been checked and are complete. Glycol systems have been filled with glycol solution to the specified concentration.

.1 Contractor shall employ a Chemical Treatment Specialist who shall assist the Contractor with selection of the chemical treatment system, inspect the installation and test the system. Specialist shall complete manufacturers' testing forms and submit a report to the Consultant.

.2 Specialist shall assist Contractor to clean all piping systems. Specialist shall take samples and repeat the cleaning process if specification requirements are not met.

.3 Specialist shall assist Contractor and add chemical immediately after the cleaning process for each system for protection. The specialist shall take samples and repeat the process until specification requirements are met.

.4 Specialist shall revisit the site after 1 month of operation of each system and re- test systems.

.10 All systems have been checked for pressure and leakage

.11 All vibration isolators and seismic restraints have been checked, adjusted, and shimmed as necessary

.12 All control and alarm functions have been checked and are operational.

.13 Any self-diagnostic packaged control systems have been checked and are operational.

.14 Strainers, traps, filters, etc. have been cleaned out. All strainers and traps shall be tagged with the date of inspection and cleaning noted.

.2 All deficiencies shall be recorded and reviewed by the commissioning team, and shall be corrected and verified prior to proceeding to the next Commissioning Phase.

.3 When all the above has been completed in a satisfactory manner the contractors may proceed to Phase 2 – System Activation, Testing and Balancing.

.3 Phase 2 - System Activation, Testing and Balancing: This phase shall include, but not necessarily be limited to the following:

.1 Mechanical Systems - General

.1 Activation of all systems, sub-systems, and equipment.

.2 Check out operation of all equipment and machinery. Check rotational direction of all moving equipment.

.3 Check for any abnormal equipment vibration and noise. Determine cause and rectify.

.4 Complete all system identification, labels, nameplates, pipe identification, colour coding, flow arrows, sprinkler signs, hydraulic data plates, etc.

.5 Adjust vibration isolators and seismic restraints as required.

.6 Clean out all strainers, traps, filters, etc. All strainers and traps shall be tagged with the date of inspection and cleaning noted.

.7 All deficiencies shall be recorded and reviewed by the commissioning team, and shall be corrected and verified prior to proceeding further.

.8 If, in the opinion of the Consultant and/or CA, field operations and testing indicates that any item of equipment or machinery does not meet the specifications, the Owner may request that testing of the equipment in question be carried out by an independent testing laboratory or testing agency. In the event that the tested equipment or machinery proves to meet the specification, the Owner shall pay for the independent lab testing. If the equipment or machinery does not meet the specification the Contractor will be responsible to pay the costs of all testing and the costs of all alterations to the equipment or machinery to bring it up to specifications, any subsequent testing, or the complete cost of replacing the equipment or machinery with new equipment or machinery that meets the specifications.

.2 Plumbing Systems: Provide start-up, set up, adjustment and recording of the operational data for all systems and components as related to the project, including but not limited to

.1 Incoming municipal water pressure.

.2 Pressure reducing valve set points and downstream pressures.

.3 Domestic water heater temperature set points.

.4 Central and individual tempered water mixing valve set points.

.5 Balancing of the hot water recirculation systems.

.6 Operation of all plumbing fixtures including adjustments of all flush valves.

.7 Set points for all control devices.

.8 Testing and certification of all backflow preventers.

.3 HVAC Systems:

.1 Provide the services of a factory authorized representative for the start-up of all major and/or specialty equipment, including but not limited to the following. Provide a written report on forms provided by manufacturer.

.1 Variable Frequency Drives

.2 Packaged Ventilation Equipment (Air Handling Units / HRVs)

.3 Testing and adjusting of all systems and equipment.

.4 Balancing of all air systems and locking all balance dampers.

.5 Balancing all water systems and locking all balancing valves.

.6 Set and adjust all air grilles, registers, and diffusers for proper throw and distribution and optimum comfort.

.7 Set up all constant volume and variable volume fans. Adjust drives or change drive or driven sheaves as required.

.8 Set up and adjust all variable volume boxes and air valves.

.9 Plug all air pressure and flow measurement holes in ducts and plenums.

.10 Verify and certify that all fire dampers are operational and accessible for maintenance. Ensure that fusible links are correct rating for the location and duty and that they are readily accessible for replacement.

.11 Verification of water tightness of all roof and exterior wall penetrations.

.12 Verification and certification of fire-stopping and sealing of all HVAC, Plumbing, and Sprinkler penetrations through all rated and non-rated fire separations and sound separations.

.13 Verification that all coil drain pans are clear and functional.

.14 Verify and certify that the building side of the geothermal loop has been completely flushed of air and is ready for connection to the field geothermal loop. Both the Geothermal Contractor and Mechanical Contractor shall certify that the building loop and field loop are ready to be interconnected.

.15 Fit all air filters with new filter media and provide spare filter media as specified.

.16 All problems revealed by the Balancing Agency shall be rectified, fan speeds shall be altered as required, and drive and driven sheaves shall be replaced as necessary. The Contractor shall be prepared to provide labour and material to replace drives and driven sheaves if required to properly balance fan systems at no additional cost to the contract.

.17 System operations in the fire mode shall be tested in the presence of the authorities having jurisdiction. Obtain a written statement/certificate of approval of all operations.

.18 System operations in the emergency power mode shall be tested in coordination with Division 26. Obtain a written statement/certificate of approval of all operations.

.4 Building Automation and Control Systems

.1 The Building Automation and Controls Systems shall be fully tested and commissioned by manufacturer's technician to operate in the manner defined by the specifications.

.2 EMCS Contractor shall provide an operating terminal and sufficient training and instruction to TAB Contractor which will allow them to set-up and balance the water and air systems.

.3 A point-to-point testing shall be done by EMCS Contractor. This test shall include, but is not limited to:

.1 Ensuring that wiring is accurately connected to appropriate terminals;

.2 Check and verify that each input point is reporting to the Building Automation and Controls Systems panels and workstations in the normal state and change or state

.3 Checking the function of each control and controlled device (such as the beginning, end and extent of actuator travel);

.4 Connection integrity between actuator and device;

.5 Calibration of sensors;

.6 Output from sensors;

.7 Operation of relays;

.8 Data/information integrity at console;

.9 Remote reset integrity from console to field device;

.10 Interfacing with other systems such as life safety monitoring system.

.11 EMCS contractor in conjunction with the mechanical contractor shall create simulated design load conditions for control verification tests.

.4 Provide the calibration procedure for each analog sensor. Physically check the calibration of each analog sensor type using a calibrated instrument prior to testing. All procedures used shall be fully documented on the prefunctional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

.5 Verify that all safeties are operating (ie. freeze-stats).

.6 Check out sequence of operation step by step.

.7 EMCS Contractor shall provide a print-out of general and critical alarm lists and all points connected to the Building Automation and Controls Systems. The all point log shall be sub-divided into points per system. One report shall be taken prior to the acceptance test.

.8 Create false alarms at each point and provide a print-out of the test;

.9 Verify that each time of day and optimum start program is operational in software and at the device

.10 When all the above has been completed in a satisfactory manner the system shall go through a process of fine tuning of controls and systems operations.

.11 Recheck operation and calibration of all controls, instruments, and operators. Recalibrate as required. All controls shall be fine tuned for accurate response, precise sequencing, and smooth operation.

.12 All set points and schedules shall be reviewed and adjusted as required.

.13 Summary Multi-trends are created for all systems and equipment

3.4. FUNCTIONAL PERFORMANCE TESTING

.1 General

.1 Refer to Section 01 91 13 for a list of systems to be commissioned and to Divisions 20 - 25 technical specifications for a description of the process and for specific details on the required functional performance tests.

.2 The commissioning procedures and functional testing do not relieve the contractor of the responsibility to provide all products and labour required to furnish the Owner with complete, functional building systems, or partially shift that responsibility to the CA, or Owner.

.3 Functional testing is intended to begin upon completion of the Start-Up, Prefunctional Checklists and Initial Checkout - Phase 2 – System Activation, Testing and Balancing

.4 Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA, CM, and Owner.

.5 The functional performance testing phase shall not commence until the Start-Up activities have been completed to the satisfaction of the CA. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

.2 <u>Phase 3 – Verification of System Performance</u>

.1 Mechanical Equipment functional performance testing process shall include, but not be limited to, the following:

.1 Confirming the ease of access to all equipment requiring servicing, including motors, filters, coils, drives, control dampers, automatic dampers, backdraft dampers, fire dampers, fusible links, damper operators, etc

.2 Confirming the operation and sequencing of all automatic control dampers, linkages, control valves, and control devices, etc.

.3 Confirming the proper response and operation of all variable volume pump controls.

.4 Confirming the operation of all systems and equipment under all modes of operation, including emergency power and fire alarm mode.

.5 Inspecting and verifying that all piping systems, drain pans, etc., are clean and that the recommended water treatment is up to specification.

.6 Any failure will result in termination of inspection and future 100% inspections will be at the contractor's cost.

.2 EMCS Functional Performance Testing procedure:

.1 EMCS System Demonstration to CA

.1 Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests.

.2 The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the 3.3.9 of this specification. The CA will be present to observe and review these tests. The CA shall be notified at least 10 days in advance of the start of the testing procedures.

.3 The demonstration process shall follow that approved in "Submittals". The approved checklists and forms shall be completed for all systems throughout the demonstration.

.4 The contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes.

.5 The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.

.6 As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed. This will form part of the "Point Verification Report".

.7 Verification of all input/output points with regards to proper operation. CA will inspect 100% of all points for physical installation, including conduit, wire, labels, connections, etc.

.8 CA may choose to randomly inspect 50% of each point type for input/output response.

.2 Final Acceptance:

.1 This phase shall consist of verifying to CA that the deficiencies as identified during "Demonstration" have been rectified. If deficiencies are still found, the Contractor will have one week to correct them and costs for additional inspection shall be billed to the contractor.

.2 Demonstrate compliance with "System Performance".

.3 Demonstrate and simulate compliance with Sequences of Operation through all modes of operation.

.4 Demonstrate complete operation of Operator Interface.

.5 Additionally, the following items shall be demonstrated:

.1 DDC Loop Response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the contractor.

.2 Optimum Start/Stop. The contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

.3 Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the CA. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes.

.4 A power failure for the building will be simulated and proper system operation and recovery observed.

.3 Integration Testing:

.1 Upon completion of individual system tests, tests of the integrated systems shall be performed to verify that all components work together.

3.5. TESTING DOCUMENTATION, NON-CONFORMANCE, AND APPROVALS

.1 Refer to Section 01 91 13 for specific details on non-conformance issues relating to pre-functional checklists and tests.

.2 Refer to Section 01 91 13 for issues relating to functional performance tests.

3.6. OPERATION AND MAINTENANCE (O&M) MANUALS

.1 Contractor shall compile and prepare documentation for all equipment and systems covered in the Divison 22 - 25 sections of the Performance Specification documents.

.2 Contractor shall deliver O&M documents according to Section 01 91 13 Commissioning General Requirements and other applicable sections of the Performance Specification documents.

.3 The CA shall receive a copy of the O&M manuals for review.

.4 Systems Manual Requirements: The contractor shall provide the following information to the CA to assist in compilation of the Systems Manual. The CA is responsible for production of the Systems Manual.

Information to be provided by the contractor includes:

.1 Approved equipment submittals including Sequence of Operation

.2 Contractor & Supplier listing with contact information

.3 All data generated during the commissioning process, including start-up reports, evaluation checklists and completed test certificates and reports

.4 Equipment Operating schedules including set points

.5 Manufacturer’s recommended calibration and preventive maintenance instructions.

.5 Special Control System O&M Manual Requirements:

In addition to documentation that may be specified elsewhere, the controls contractor shall compile and organize at minimum the following data on the control system in labeled 3-ring binders with indexed tabs.

.1 Three copies of the controls training manuals in a separate manual from the O&M manuals.

.2 Operation and Maintenance Manuals containing:

.1 Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step- by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.

.2 Full as-built set of control drawings (refer to Submittal section above for details).

.3 Full as-built sequence of operations for each piece of equipment.

.4 Full points list.

.5 Full print out of all schedules and set points after testing and acceptance of the system.

.6 Full as-built print out of software program.

.7 Electronic copy on disk of the entire program for this facility.

.8 Marking of all system sensors and thermostats on the as- built floor plan and mechanical drawings with their control system designations.

.9 Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.

.10 Control equipment component submittals, parts lists, etc.

.11 Warranty requirements.

.12 Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).

.3 The manual shall be organized and subdivided with permanently labeled tabs for each of the following data:

.1 Sequences of operation

.2 Control drawings

.3 Points lists

.4 Controller / module data

.5 Thermostats and timers

.6 Sensors and DP switches

.7 Valves and valve actuators

.8 Dampers and damper actuators

.9 Program setups (software program printouts)

.4 Field checkout sheets and trend logs should be provided to the CA for inclusion in the Commissioning Report.

.6 Special TAB Documentation Requirements:

.1 The TAB will compile and submit the following with other documentation that may be specified elsewhere in the Specifications.

.1 Final report containing an explanation of the methodology assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.

.2 The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

.7 Review and Approvals

.1 Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CA. Refer to Section 01 78 00 for details.

.8 Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CA. Refer to Section 01 91 13 for details.

3.7. TRAINING OF OWNER PERSONNEL

.1 Demonstration and training shall not proceed until the following tasks and deliverables have been completed and reviewed/approved by the CA:

.1 Functional Performance Testing Completed, including Issues Log summarizing status/remaining issues. Systems verified to be operating to design intent.

.2 O&M Manuals have been reviewed, approved, and final version submitted to the owner

.3 Record Drawings completed and submitted to the owner. In the absence of final Record Drawings, a full colour, full size scanned copy of the as-builts may be provided by the contractor in both hard and digital copy.

.2 Detail information regarding contents, duration and instructors for any particular system is included in Section 01 79 00.13: Commissioning – Demonstration and Training.

.3 Mechanical Contractor: The mechanical contractor shall have the following training responsibilities:

.1 Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01 79 00.13.

.2 Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, p, heat, air handling units, fans, terminal units, controls and water treatment systems, etc.

.3 Training shall normally start with classroom sessions 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 controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

.7 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.

.4 The TAB contractor shall have the following training responsibilities: TAB shall meet with facility staff after completion of TAB and instruct them on the following:

.1 Go over the final TAB report, explaining the layout and meanings of each data type.

.2 Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

.3 Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.

.4 Discuss any temporary settings and steps to finalize them for any areas that are not finished.

.5 Other salient information that may be useful for facility operations, relative to TAB.

3.8. DEFERRED AND SEASONAL TESTING

.1 Refer to Section 01 91 13 for general requirements of post occupancy and deferred testing.

.2 The Contractor shall allow for any site visits to the site for general trouble shooting and overseeing the operation and maintenance of all systems and equipment during the first full year warranty period following the final commissioning and Substantial Completion being issued.

.1 These site meetings are over and above normal trouble and warranty call backs.

.2 These site visits shall be coordinated with post-occupancy review performed by the design professionals and Commissioning Authority.

.3 The purpose of these site visits is to investigate and troubleshoot the system operations and any problems and to ensure that all systems and equipment are being properly operated and maintained.

.3 EMCS Contractor shall revisit the site during the first year of operation to review the performance of the Building Automation and Controls Systems. The review shall include DDC loop tuning, sensor calibration, programs, communication, DDC panels, workstations and the operational logs. The visits shall be a minimum of 8 hours each visit. The visits shall be:

.1 Beginning of cooling season;

.2 During the cooling season;

.3 Beginning of heating season;

.4 During the heating season.

.4 The Owner’s Facility Group shall be responsible for notification to all relevant contractors and/or suppliers who would be involved in the adjustment, repair, or replacement of any part of a system under warranty. The CA shall be informed by the Owner of all major commissioning-related issues identified during the warranty phase.

.5 Following each visit to the site, the Contractor shall submit a detailed report to the Owner’s Facility Group, CA, and the Consultant outlining his findings at the site, any problems encountered with the operation and maintenance of all systems, and any repair work or correctional action taken and the outcome of same.

3.9. WRITTEN WORK PRODUCTS

.1 Contractor's written work products will consist of the startup and initial checkout plan and functional testing described in this section and Section 01 91 13 Commissioning – General Requirements and the completed startup, initial checkout and pre-functional, and functional checklists.

END OF SECTION

1 FACILITY NATURAL-GAS PIPING

1.1. RELATED REQUIREMENTS

.1 Section 01 00 10 – General Instructions.

.2 Section 23 05 05 – Installation of Pipework.

.3 Section 23 05 19.01 –Thermometers and Pressure Gauges – Piping Systems.

1.2. REFERENCES (LATEST REVISIONS)

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B16.5 – Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

.2 ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

.2 American Society for Testing and Materials International (ASTM):

.1 ASTM A47/A47M-99 – 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 A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.4 ASTM A181/A181M, Specification for Carbon Steel Forgings, for General Purpose Piping.

.5 ASTM A234/A234M, Standard Specification for Piping Fittings of

.6 Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

.7 ASTM B75/B75M – Standard Specification for Seamless Copper Tube Metric.

.8 ASTM B837 – Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA)/CSA International:

.1 CSA W47.1 – Certification of companies for fusion welding of steel.

.4 Canadian Standards Association (CSA)

.1 CAN/CSA B149.1 – Natural Gas and Propane Installation Code.

.2 CAN/CSA B149.2 – Propane storage and handling code.

.5 Health Canada - Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheet (MSDS).

.6 Material Safety Data Sheet (MSDS).

2 PRODUCT

2.1. GAS PIPING

.1 Provide gas piping in compliance with CSA B149.1, and to the approval of the local Gas Utility and local authorities.

.2 Gas piping shall be Schedule 40 ASTM-A53 with screwed fittings up to 65mm (2-1/2“) dia. And Schedule 40 standard steel butt-welding fittings for 75mm (3“) dia. Pipe and above.

.3 Gas vent piping shall be type 'L' hard copper with wrought copper or cast brass fittings and 95/5 solder joints.

.4 Steel, ASTM A234, malleable iron threaded fittings, Tube-Turn, Schedule 40.

.5 Subject gas piping to an air pressure test of 1,035 kPa (150 psi) for two (2) hours without leakage and test joints with a soap solution while the piping is under pressure. Purge after pressure test in accordance with CSA B149.1.

.6 Joints:

.1 Welded, screwed, malleable iron.

.7 Flanges:

.1 Welding neck, class 125, ASTM A181, Tube-Turn flat face.

.8 Flange gaskets:

.1 Albion asbestos No. 92, thickness of 1.6 mm.

2.2. GAS VALVES

.1 Valves shall be CSA approved (CGA 3.16) lubricated all iron plug valves or ball valves.

.2 Install valves in the following locations:

.1 At each single item of equipment.

.2 Main gas service before entering building.

.3 Outside mechanical rooms containing gas fired equipment.

.4 All branch gas lines from risers.

.5 Outside kitchens containg gas fired equipment.

2.3. PRESSURE GAUGES

.1 See Section 23 05 19.01 - Thermometers and Pressure Gauges – Piping Systems.

2.4. PAINT

.1 All piping and vents for natural gas, must be painted with a coat of mordant and two coats of very visible yellow paint approved by the section providing piping.

3 EXECUTION

3.1. MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written requirements, recommendations, and specifications, including any available product technical bulletins, instructions for handling, storage, and installation and instructions in technical data sheets.

3.2. PIPING

.1 Install piping in accordance with the Section 23 05 05 - Installation of Pipework, applicable provincial/territorial regulations, CAN/CSA B149.1, and this section's requirements.

.2 Provide drip points in the following locations:

.1 At low points in piping system.

.2 At all connections to equipment.

3.3. VALVES

.1 Install valves at branches, in order to isolate each device, and as indicated.

3.4. TESTING, BALANCING AND CLEANING

.1 General:

.1 Perform all tests specified below.

.2 All tests must have been conducted satisfactorily before requesting an inspection by the engineer.

.3 All piping or part thereof must be tested before being covered with insulation or being concealed in partitions, ceilings, or walls. Prior to pressure testing systems, remove or protect devices such as control devices, air vents, or any equipment that is not designed to be subjected to pressures corresponding to those used during the tests.

.4 During hydrostatic testing, ensure that the piping is completely filled with liquid and purged of all air.

.5 In cold weather, use antifreeze for hydrostatic tests, and at the end of the tests, drain piping completely to prevent any risk of freezing.

.6 Provide three copies of all tests and adjustments executed, indicating

.7 final readings obtained, for review comments, and approval. Provide results on 216 mm x 279 mm paper, providing the name of the system, the device, the requested characteristics, and those obtained.

.2 Natural gas piping:

.1 Submit piping to a pressure test for a duration and at a pressure corresponding to the requirements of the table "PRESSURE TEST REQUIREMENTS" CSA B149.1 according to the pressure and the length of the system. Use a pressure gauge graduated from 0 to 690 kPa maximum.

.2 Subject gas piping to an air pressure test of 1,035 kPa (150 psi) for two (2) hours without leakage and test joints with a soap solution while the piping is under pressure. Purge after pressure test in accordance with CSA B149.1

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 Related Requirements

.1 Section 23 05 00 Common Work Restrictions.

1.2. REFERENCES (LATEST REVISIONS)

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)

.1 ANSI/AWS A5.8/A5.8M, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASME B16.3, Malleable Iron Threaded Fittings.

.3 ASME B16.5, Pipe Flanges and Flanged Fittings.

.4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series).

.6 ASME B18.2.2, Square and Hex Nuts (Inch Series).

.7 ANSI/ASME B16.4, Gray-Iron Threaded Fittings.

.8 ANSI/ASME B16.15, Cast Bronze Threaded Fittings.

.9 ANSI B16.18, Cast Copper Alloy, Solder Joint Pressure Fittings.

.10 ANSI/ASME B16.22, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials International (ASTM)

.1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A 536, Standard Specification for Ductile Iron Castings.

.4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E 202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.7 ASTM B 32, Standard Specification for Solder Metal.

.8 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.

.9 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.10 ASTM B 88M, Standard Specification for Seamless Copper Water Tube [Metric].

.11 ASTM E 202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.4 American Water Works Association (AWWA).

.1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 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 (Developed in cooperation with the Canadian Welding Bureau).

.7 Manufacturers Standardization Society (MSS)

.1 MSS SP 67, Butterfly Valves.

.2 MSS SP 70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS SP 71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS SP 80, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS SP 85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC]. 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] and Section [23 05 00 - Common Work Results for HVAC].

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC].

.1 Shop drawings:Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

.2 Indicate on manufacturers catalogue literature the following: VALVES.

.3 Quality assurance submittals: submit following in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC].

.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 00 - Closeout Submittals.

1.4. QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5. MAINTENANCE

.1 Extra Materials:

.1 Furnish 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.

1.6. DELIVERY, STORAGE AND HANDLING

.1 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 PRODUCTS

2.1. PIPE, FITTINGS AND JOINTS

.1 **Black Steel - Screwed Joint**: Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 **Black Steel - Welded Joint**: Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.

.3 **Black Steel - Grooved End Mechanical Joint**: Mild black carbon steel, Grade B, ASTM A53, factory or site roll grooved, complete with Victaulic cast ductile iron grooved end fittings, including full flow elbows, conforming to ASTM A536, and Victaulic Style 107 "QuickVic" rigid couplings for sizes 50 mm (2”) to 200 mm (8”), Victaulic Style 07 “Zero- Flex” rigid couplings for sizes 250 mm (10”) to 300 mm (12”), Victaulic Style W07 AGS rigid couplings for sizes 350 mm (14”) to 1525 mm (60”).

.4 **Soft Copper Pipe**: Type "L" seamless soft copper to ASTM B77.

.5 **Hard Copper - Solder Joint**: Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin/5% Antimony solder joints.

.6 **Hard Copper - Pressure Coupled Joint**: Type "L" hard drawn seamless copper to ASTM B88, complete with Rigid Tool Co. "ProPress with Smart Connect feature" system copper fittings with EDPM seals, and pressure type crimped joints made by use of a Rigid Tool Co. Model RP 330 or Model RP 210 electro-hydraulic crimping tool.

2.2. PIPING UNIONS

.1 **Screwed Piping**: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 **Flanged Piping**: Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.3. SHUT-OFF VALVES

.1 **Ball Type**: Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle. Acceptable products are:

.1 Toyo Valve Co. Fig. 5044A;

.2 Watts Industries (Canada) Inc. #FBV-3;

.3 Kitz Corp. Code 58;

.4 Victaulic Co. of Canada Ltd. Series 722;

.5 Apollo Valve #77-100.

.2 **Butterfly Type**: Cast or ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile aluminum bronze disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with the valve closed and either side of the connecting piping removed. Acceptable products are the following and/or approved equal:

.1 DeZurik of Canada Ltd.;

.2 Victaulic Co. of Canada Ltd;

.3 Apollo Valve;

.4 MAS D&S Series

.5 MAS W 50 series Grooved

.6 Watts Industries (Canada) Inc. #BF-03

2.4. SWING CHECK VALVES

.1 **Bronze - Screwed**: Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends. Acceptable products are the following and/or approved equal:

.1 Toyo Valve Co. Fig. 236A;

.2 Nibco #T-433;

.3 Kitz Corp. Code No. 23.

.2 **Steel - Grooved Ends**: Victaulic Co. of Canada Ltd. Series 716, 779 or W715 grooved end carbon steel check valves suitable for mounting horizontally or vertically.

.3 **Cast Iron - Screwed and Flanged**: Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required. Acceptable products are the following and/or approved equal:

.1 Toyo Valve Co. Fig. 435A;

.2 Watts Industries (Canada) Inc. #F-511;

.3 Kitz Corp. Code No. 78.

2.5. VERTICAL LIFT CHECK VALVES

.1 Class 150, 1380 kPa (200 psi) WOG rated bronze vertical lift check valves, each complete with screwed ends and a bronze disc. Acceptable products are the following and/or approved equal:

.1 Watts Industries (Canada) Inc.;

.2 Kitz Corp. Code No. 36.

2.6. WAFER CHECK VALVES

.1 Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38°C (100°F), non-slam wafer check valves, each complete with a carbon steel body, stainless steel discs, a shaft, springs, disc stop and thrust bearings constructed of type 316 stainless steel, and seat materials to suit the application. The inside diameter of the valve must equal the inside diameter of the connecting pipe. Acceptable products are the following and/or approved equal:

.1 Gulf Valve Co. "WAFER CHECK";

.2 Watts Industries (Canada) Inc.;

.3 The Metraflex Co.

.4 Mueller #72 Series

2.7. DRAIN VALVES

.1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm (¾") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") diameter hose, and a cap and chain. Acceptable products are the following and/or approved equal:

.1 Toyo Valve Co. Ltd. Fig. 5046;

.2 Watts Industries (Canada) Inc.;

.3 Kitz Corp. Code No. 68AC;

.4 Apollo Valves.

2.8. CIRCUIT BALANCING VALVES

.1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter. Acceptable products are:

.1 Victaulic Co. of Canada Ltd. (Tour & Andersson) Series 787 screwed, Series 788 flanged, and 789 grooved end, and Series 78K "Koil Kit" valves.

.2 RWV 9517Series Screwed, RWV 9574 Flanged series, RWV CKS Series Fan coil kits

2.9. DIFFERENTIAL PRESSURE CONTROL VALVES

.1 Differential pressure controllers used in conjunction with balancing valves to stabilize differential pressure across loads, equal to:

.1 2” (DN50) and Smaller Sizes:

.1 Tour & Andersson Series 793 STAP, 300 psi (2065 kPa), y-pattern, globe type with threaded ends, non-ferrous Ametal® brass copper alloy body and cone, EPDM o-ring seals, HNBR membrane and stainless steel spring, adjustable setpoint, shut off function and connections for portable differential meter.

.2 Sizes 2-1/2” (DN65) through 4” (DN100):

.1 Tour & Andersson Series 794 STAP, 300 psi (2065 kPa), y-pattern, globe type with flanged ends, ASTM A536 ductile iron body, all other metal parts and cone of Ametal® brass copper alloy, EPDM o-ring seals, HNBR membrane and stainless steel spring, adjustable set point, shut off function and connections for portable differential meter.

2.10. RADIATOR SHUT-OFF AND BALANCING VALVES

.1 Heavy pattern, straight, 1750 kPa (250 psi) rated at 120°C (250°F) bronze radiator valves, each complete with composition disc, spring loaded packing, and union. Inlet valves are to be equipped with a handle for shut-off. Outlet valves are to be equipped with a lockshield for shut-off and balancing. Acceptable products are:

.1 Dahl Brothers Canada Ltd. #11042 and #13013;

.2 Spirax Sarco Ltd. Type R.

3 EXECUTION

3.1. DEMOLITION

.1 Do all required hydronic piping system demolition/revision work. Refer to demolition requirements specified in the mechanical specifications.

3.2. PIPING INSTALLATION REQUIREMENTS

.1 Provide all required hydronic piping. Pipe, unless otherwise specified, is to be:

.1 for pipe to and including 65 mm (2½") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;

.2 for pipe 50 mm (2") to 300 mm (12”) diameter and larger, Standard weight black steel (10 mm/0.375” thickness) with grooved ends and Victaulic fittings and couplings, or, Standard weight black steel (10 mm/0.375” thickness) with welding fittings and welded joints;

.3 for short branch connections to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.

.2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.

.3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control. Refer to drawing control diagrams and details.

.4 Connect equipment provided as part of the work of other Sections of the Specification with piping as indicated and/or required. Refer to pipe connection details on drawings.

.5 **Unions**: Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at all equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on the drawings.

.6 **Shut-off Valves**: Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on the drawings. Valves in piping to and including 50 mm (2") diameter are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate all valves so that they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.

.7 **Check Valves**: Provide a check valve in the discharge piping of every pump, and elsewhere in piping where shown on the drawings. Where check valves are required in vertical piping, ensure that they are suitable in all respects for the application. Note that check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.

.8 **Drain Valves**: 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 shown and/or specified.

.9 **Circuit Balancing Valves**: Provide circuit balancing valves in piping generally where shown on the drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation. Balancing valves to be sized according to design flow. Ensure that balancing valves are a minimum of 10 pipe diameters downstream of any pump, 5 pipe diameters downstream of any or fitting and a minimum of 2 pipe diameters upstream of any fitting.

.10 **Differential Pressure Control Valves:** Provide as indicated on drawings and schematics. Mechanical contractor shall consult with balancing valve manufacturer to ensure correct valve selection and installation in accordance with manufactures recommendation.

.11 **Grooved Piping Systems:** Install grooved joints in accordance with Victaulic's latest published installation instructions. Ensure grooved ends are clean, free from indentations, projections, and roll marks in the area from pipe end to groove. Select gaskets with an elastomer grade suitable for the intended service and produced by the coupling manufacturer. Provide on-site training in the use of grooving tools and installation of grooved joint products for field personnel from grooved coupling manufacturer's factory trained representative. All grooved products to be from a single manufacturer

3.3. FLUSHING AND CLEANING PIPING

.1 Flush and clean new piping in accordance with requirements specified in the mechanical work Section entitled HVAC Water Treatment.

3.4. TESTING, ADJUSTING AND BALANCING

.1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 23 05 00 Common Work Requirements

.2 Section 23 05 16 Expansion Fittings and Loops for HVAC

1.2. REFERENCES (LATEST REVISIONS)

.1 American Society of Mechanical Engineers (ASME)

.1 ASME, Boiler and Pressure Vessel Code.

.2 ASTM International Inc.

.1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A 278/A 278M, Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A 516/A 516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A 536, Standard Specification for Ductile Iron Castings.

.5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code, Supplement#1.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC].

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

1.4. CLOSEOUT SUBMITTALS

.1 Submit maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

1.5. DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.1. HYDRAULIC SEPARATORS LOW LOSS HEADER

.1 Hydraulic Separator device shall be constructed of steel. It shall be designed, fabricated and stamped per ASME Section VIII Division 1 with a maximum working pressure of 125 psi at 270°F. Manufacturer shall be holder of ASME U stamp. Manufacturer to have optional 250 psi and 150 psi ASME units available.

.2 Units provided with flanged system connections as standard. Inlet and outlet connections to the primary and secondary circuits to be on the same side of the unit.

.3 Each hydraulic separator device shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. The air vent shall be able to be closed to allow flushing and purging of dirt via side port without dirt passing through vent on initial system fill.

.4 A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and removal of the floating impurities from the air system interface within the separator.

.5 A blow down valve shall be provided by the unit manufacturer on the bottom of each unit to allow blow down and cleaning. On units

.6 2 ½” and smaller the valve and all of its fittings shall be 1”. On units three 3” and larger the valve and all openings shall be 2”.

.7 The integral air and dirt separator shall remove air down to 18 microns and shall remove dirt/debris down to 35 microns. The unit shall be 100% efficient at removing dirt down to 90 microns in 100 passes or less.

.8 The unit manufacturer shall provide the owner and design engineer third party independent test data certifying that their unit performs to the above standards. Suppliers not providing these independent performance test results will not be acceptable.

.9 The integral air and dirt separator shall employ the use of high surface area pall rings to achieve optimal separation of air and dirt with minimal pressure drop. The pall rings shall be made of stainless steel. Stainless steel will be the only acceptable material used for suppressing turbulence and increasing surface area for high efficiency air and dirt removal. Inferior materials of construction such as copper for the straining medium will not be acceptable.

.10 Manufacturer must have at least 15 years of experience with microbubble coalescing and dirt removal technology.

.11 The unit shall be manufactured with a removable cover to facilitate removal, inspection, and cleaning of the pall ring basket. The entire pall ring basket shall be constructed of stainless steel. For safety and ease of service the unit shall be accessed from the top and the pall ring basket shall be accessed as one complete assembly housed in a stainless steel cage.

2.2. AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 310 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

2.3. AIR SEPARATOR BOILER MOUNTED

.1 Complete with dip tube.

.2 Working pressure: 860 kPa

2.4. AIR SEPARATOR- EXPANSION TANK FITTING

.1 Complete with adjustable vent tube and built-in manual vent valve.

.2 Working pressure: 860 kPa.

2.5. AIR SEPARATOR- IN-LINE

.1 Working pressure: 860 kPa.

.2 Size: NPS 1 ½

2.6. COMBINATION SEPARATORS/ STRAINERS

.1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.7. COMBINATION LOW PRESSURE RELIEF AND REDUCTING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.8. PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B 62, solder end or screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A 278/A 278M, Class 30, cast iron body to ASTM A 278/A 278M, Class 30, flanged connections.

.3 NPS 2 to 12: T type with [ductile iron body to ASTM A 536] malleable iron body to ASTM A 47M, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel or brass with 1.19 mm perforations.

.6 Working pressure: 860 kPa.

2.9. SUCTION DIFFUSER

.1 Body: cast iron with flanged or screwed connections.

.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure gauge tappings.

.6 Adjustable support leg.

2.10. FLO-TREX COMBINATION VALVE.

.1 Each valve is to incorporate the following three functions in one body:

.1 Tight shut-off

.2 Spring-closure type silent non-slam check

.3 Effective throttling design capability

.2 Note: The throttling function should not be used in variable speed applications and is to be used only to alleviate any noise, vibration or cavitation where a speed reduction to design flow solution will not eliminate these symptoms

.3 The body shall have (2) 1/4” NPT connections on each side of the valve seat. One connection on each size shall have brass pressure and temperature metering ports, with Nordel check valves and gasketed caps. The other connection on each side shall be supplied with brass drain plugs. Metering ports are to be interchangeable with drain plugs to allow for measurement flexibility when installed in tight locations. The valve disk shall be bronze plug & disc type with high impact engineered resin seat to ensure tight shut-off and silent check operation.

.4 The valve stem shall be stainless steel with flat surfaces provided for adjustment with open-end wrench.

.5 For Grooved Piping: The valve body shall be ductile iron with grooved ends and anti-rotation lugs on the inlet and outlet of the body.

.6 Flange adapters (Where necessary) are to be ANSI 125 (ANSI 250, PN16, PN25) ductile iron flanges with anti-rotation lugs and EPT gaskets.

.7 For ANSI 150 (PN16) Welded Flanged Piping: The valve body shall be Cast Iron with ANSI 125 (PN16) flanged ports.

.8 For ANSI 300 Welded Flanged Piping: The valve body shall be Ductile Iron with ANSI 250 (PN25) flanged ports.

.9 The valve shall be selected and installed in accordance with the manufacturer’s instructions and be suitable for the pressure and temperature specified.

.10 Insulation (Available 2.5” – 6” Flo-Trex Valves)

.11 Each valve shall be furnished with a pre-formed removable PVC insulation jacket to meet ASTM D1784 Class 14253- C, MEA #7-87, ASTM-E-84 and ASTM136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less. There will be provided sufficient mineral fiberglass insulation to meet ASHRAE 90.1-1989 specifications in operating conditions with maximum Fluid Design Operating Temperature Range of 141°F-200°F (60°C-93°C) and Mean Rating Temperature of 125°F (52°C).

2.11. SUCTION GUIDES

.1 Furnish and install on the suction of each pump a Suction Guide, with Outlet Flow Stabilizing Guide Vanes, removable Stainless Steel Strainer and Fine Mesh Start-up Strainer.

.2 For 150 psig flanged pipe system: Supply Suction Guide with Cast Iron body with ANSI 125 flanged ports.

.3 For 300 psig flanged pipe system: Supply Suction Guide with Ductile Iron body and ANSI 250 flanged ports.

.4 For grooved pipe system: Supply Suction Guide with Ductile Iron body with Grooved inlet and ANSI 125 flanged outlet connections.

.5 The mechanical contractor shall inspect the strainer prior to activating the pump and, further, shall remove the Fine Mesh Start-up Strainer after a short running period. (24 hours maximum). Space shall be provided for removal of the Strainer and connection of a Blow-down Valve

2.12. PRESSURE RELIEF VALVES

.1 ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each capable of relieving the full output of the equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified. Acceptable products are:

.1 ITT Bell & Gossett 3301/4100, or 790/1170;

.2 Dresser Industries "CONSOLIDATED";

.3 Spirax Sarco Ltd. SVI Series;

.4 McDonnell & Miller Models 250 and 260;

.5 Conbraco 10-600 Series;

.6 Watts Industries (Canada) Inc. 174A or 740.

2.13. AIR VENTS

.1 **Manual Air Vents**: Equal to Conbraco 27 Series, 3.2 mm (⅛") diameter with a key handle.

.2 **Automatic Air Vents**: Float actuated air vents, each complete with a semi-steel body and a cap, a stainless steel float assembly and seat, and a neoprene head. Acceptable products are:

.1 Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);

.2 Armstrong International Inc. No. 1-AV.

2.14. STRAINERS

.1 Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping. Acceptable products are:

.1 Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;

.2 Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;

.3 Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";

.4 Armstrong International Inc. A1 Series;

.5 Watts Industries (Canada) Inc. #77SCI;

.6 Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged.

2.15. PIPING EXPANSION JOINTS

.1 Controlled flexing, flanged expansion joints, 2070 kPa (300 psi) rated, with corrugated stainless steel bellows with closely matched neck rings and reinforcing or control rings, and selected for the operating pressure plus 25% safety factor. Acceptable products are:

.1 Senior Flexonics Ltd. Series CSF "High-Corr";

.2 Victaulic Co. of Canada Ltd. Style 155 with Style 07 or 107 "Zero-Flex" couplings on each side of the assembly and a full length steel "V" shaped support trough with hangers;

.3 The Metraflex Co. Model MC.

.2 Externally pressurized, 1380 kPa (200 psi) rated expansion joints with a stainless steel bellows and shroud, welding or threaded steel nipple ends for steel piping, and copper sweat nipple ends for copper piping. Acceptable products are:

.1 Senior Flexonics Ltd. Series "H";

.2 The Metraflex Co. Model "HP".

2.16. PIPING ALIGNMENT GUIDES

.1 Prime coat painted black carbon steel pipe alignment guides sized and fabricated to suit the pipe size and the pipe insulation thickness. Acceptable products are:

.1 Senior Flexonics Ltd. Series PGT;

.2 E. Myatt & Co. Ltd. Fig. 1267;

.3 Empire Tool & Mfg. Inc. Fig 256;

.4 The Metraflex Co. Style IV.

2.17. PIPE ANCHORS

.1 Welded structural black steel anchors of a design, size, and type to securely anchor the pipe as shown and/or required as per engineered shop drawings prepared by the Contractor. Each anchor is to be designed and detailed by a professional structural engineer registered in the place of the work. Submit anchor design, fabrication, and installation shop drawings, stamped by the design engineer.

2.18. AIR SEPARATOR

.1 Vortex type vertical air separator with side tangential inlet and outlet connections, a top air outlet connection, and bottom drain connection. The separator is to be constructed of cast iron or fabricated steel for a pressure of 1105 kPa (160 psi) at 180°C (350°F) in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

.2 Acceptable products are:

.1 S.A. Armstrong Ltd. Model "VA";

.2 ITT Bell & Gossett "Rolairtrol";

.3 Taco Canada Ltd. "Vortech".

2.19. EXPANSION TANK

.1 Diaphragm or replaceable bladder type, factory pressurized expansion tank with permanent separation of air and water, as per the drawing schedule and complete with:

.1 a steel pressure tank suitable for a working pressure of 870 kPa (125 psi) at 115°C (240°F), constructed and stamped in accordance with the ASME Code for Unfired Pressure Vessels and complete with a system connection, drain connection, air charging valve, and a red oxide primer finish;

.2 a heavy-duty butyl rubber (EDPM) bladder;

.3 a tapping for installation of a pressure gauge;

.4 for horizontal tanks only, mounting saddles supplied loose;

.2 Acceptable products are:

.1 S.A. Armstrong Ltd. Series "AX-V" or Series "L";

.2 ITT Bell & Gossett Series "B" (ASME);

.3 Amtrol "Extrol";

.4 Hamlet & Garneau Inc. AL Series "Expanflex".

3 EXECUTION

3.1. APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2. GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

.5 Provide line size vortex air separators in hot water heating systems

.6 The separator package shall provide for direct pumping through a specific centrifugal-action solids-from-liquid separator and immediate return of flow to system flow. Separated solids shall be continuously bled from the separator's collection chamber into the package's integral solids recovery vessel and solids collection bag. Excess liquid shall pass through the bag and return to system flow via the separator's pressure relief connection

.7 Provide galvanized drain pans below all pipes passing through Electrical, Battery, Transformer, UPS, Computer and Telephone Rooms and over horizontal runs of bus duct. Connect the drain lines to the nearest hub drain or janitor’s sink

.8 Install equipment and apparatus requiring servicing and/or replacing with unions or flanges

3.3. INSTALLATION OF STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install in the suction line of all pumps.

.4 Install ahead of each automatic control valve larger than NPS and radiation and as indicated

.5 Install upstream of pressure reducing valves

.6 Install upstream of plate and frame heat exchangers (hot and cold sides)

.7 Provide strainers with 304 stainless steel 840 micron (20 US mesh) screens for standard HVAC applications

.8 Provide Y or T type strainers with stainless steel screen. For strainers in copper pipe, provide bronze body type. For other strainers provide ductile-iron (ASTM A536 Grade 65-45-12); semi-steel (ASTM A278 class 30); fabricated steel (ASTM A53 Grade B); or cast steel (ASTM A-216 WCB). Use screwed connections up to and including DN50 (2") and grooved or flanged connections for DN65 (2-½") and larger. Provide strainers of the self-cleaning type or with access to the basket for strainer maintenance

.9 Provide hose end valves for strainers at pump suction

.10 For all strainers of the same type, furnish the same make

.11 Select strainer assemblies to suit the pressure and temperature of the application

.12 All strainers 50 mm (2”) and larger shall be provided with blow down connection and valve

3.4. INSTALLATION OF EXPANSION TANKS

.1 Adjust expansion tank pressure as indicated to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

.3 Air cushion tanks shall be galvanized steel pressurized air cushion bladder type, ASME-rated for pressure and temperature of application

.4 Each tank shall be complete with pressure gauge, drain valve and tappings

.5 Tank shall be replaceable bladder type, pre-pressurized, complete with a butyl bladder compatible with ethylene glycol

3.5. PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.6. INSTALLATION OF PRESSURE RELIEF VALVES

.1 Provide factory set pressure relief valves where shown. Pipe the discharge of each water piping relief valve to drain unless otherwise shown or specified.

.2 Pipe the discharge of each glycol solution piping relief valve back to the system expansion tank or return piping.

.3 Confirm relief valve settings.

3.7. INSTALLATION OF AIR VENTS

.1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with the drawing detail.

.2 Provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so the discharge is visible. Identify the drain piping.

3.8. INSTALLATION OF EXPANSION COMPENSATORS

.1 Provide expansion compensators for all vertical piping risers and for horizontal piping with a straight run of equal to or more than 15m (50 feet).

.2 For pipe sizes 75 mm (3”) and under and operating pressures up to 1380 kPa (200 psi) provide shrouded compensators with 2-ply stainless steel bellows, anti torque device, limit stops and internal guides.

.3 For operating pressure up to 585 kPa (85 psi) provide compensators with 2-ply phosphor bronze stainless bellows and brass protective shroud.

.4 For pipe sizes over 75 mm (3”) provide corrugated controlled flexing expansion joints with cast steel rings and stainless steel pressure carrier.

.5 For vertical risers in fan coil unit application, provide U loop type expansion compensators for all risers. Manufacturer to provide engineering calculations for all compensators in shop drawing submission.

.6 Expansion compensators may not be required on piping systems utilizing Victaulic couplings provided they are installed to Manufacturer’s requirements to offset expansion. Provide Manufacturer’s design data for acceptance by the Consultant. If Zero Flex style couplings are used, expansion compensators are required to the same conditions as specified for welded steel pipe.

.7 Provide calculations for expansion compensators certified and stamped by a professional engineer registered in the Province of Ontario.

3.9. INSTALLATION OF PIPING ANCHORS

.1 Provide anchors to secure piping to the structure. Locate anchors generally where shown as shown and/or as required withstand all anticipated static and dynamic loading conditions which may act upon the mechanical piping system. Exact locations to suit the installed piping layout and as per the requirements of the engineered anchor shop drawings.

.2 When installation of anchors is complete, arrange, and pay for the anchor design Structural Engineer to visit the site to review the anchor installation. Submit a signed letter from the Design Engineer and bearing the Engineer’s stamp to confirm that each anchor is properly installed in accordance with design requirements.

3.10. INSTALLATION OF AIR SEPARATOR

.1 Provide an air separator in piping where shown and connect with valved inlet and outlet piping.

.2 Extend valved blowdown piping from the bottom pipe connection tapping to the nearest floor drain location.

.3 Equip the top pipe connection tapping with an automatic air vent and piping as detailed.

3.11. INSTALLATION OF EXPANSION TANK

.1 Provide an expansion tank where shown.

.2 Secure the horizontal expansion tank in place from the structure by means of properly sized galvanized steel hanger rods and support saddles supplied with the tank.

.3 Secure the tank stand to a concrete housekeeping pad by means of machine bolts.

.4 Connect the tank with system piping as indicated.

.5 Connect the tank with system piping as indicated. Extend a drain line from the tank piping as indicated and terminate the drain line with a drain valve. Provide an air vent.

.6 Provide a water make-up connection line complete with relief valve and pressure gauge and connect to system piping as shown. Terminate the make-up piping for connection to domestic cold water piping as part of the work of the mechanical work Section entitled Domestic Water Piping and Valves. Check relief valve operation and adjust as required.

.7 Check the tank air charge and adjust to suit the system.

3.12. INSTALLATION OF FLEXIBLE PIPING CONNECTIONS

.1 Provide flexible connections in piping connections to equipment where shown and/or as required to prevent vibration transmission to the piping distribution system.

3.13. CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling] in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 Section Includes:

.1 Materials and installation for hydronic pumps.

.2 Related Requirements

.1 Section 23 05 00 Common Work Requirements

.2 Section 23 05 53 Identification of HVAC Piping and Equipment

.3 Section 23 05 93 Testing, Adjusting and Balancing

.4 Section 23 07 13 Mechanical Insulation

.5 Section 23 21 16 Hydronic Piping Specialties

.6 Section 25 00 01 Integrated Automation General Requirement

1.2. REFERENCE STANDARDS (LATEST REVISIONS)

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).

.1 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

.3 American National Standards Institute/International Electrical Commission (ANSI/IEC).

.1 IEC 60529, Degrees of Protection Provided By Enclosures (IP Code).

.4 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).

.1 ASHRAE 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings.

.2 ASHRAE 189.1P, Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings.

.5 ASTM International (ASTM).

.1 ASTM A48/A48M, Standard Specification for Gray Iron Castings.

.2 ASTM A536, Standard Specification for Ductile Iron Castings.

.3 ASTM A582/A582M, Standard Specification for Free-Machining Stainless Steel Bars.

.4 ASTM B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

.6 CSA International (CSA).

.1 CAN/CSA C22.2 No.108, Liquid Pumps.

.7 German Institute for Standardization (DIN).

.1 DIN EN 61800-3, Adjustable Speed Electrical Power Drive Systems - Part 3: EMC Requirements and Specific Test Methods.

.8 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE 519, Recommended Practices and Requirements for Harmonic Control In Electrical Power Systems.

.9 National Electrical and Manufacturers Association (NEMA).

.1 NEMA MG-1 Standard, Motors and Generators, Revision 1.

.10 Underwriter's Laboratories (UL).

.1 UL 778, Motor-Operated Water Pumps.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit manufacturer's installation instructions under provisions of General Conditionsand Division 1.

.3 Operation and Maintenance Data: Include installation instructions, assembly views,lubrication instructions, and replacement parts lists.

.4 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.

.5 Product Data including certified performance curves and rated capacities of selectedmodel, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.

.6 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.

.7 Specified Control Head shall be 30% TDH or calculated minimum control head specified within the equipment schedule

.8 Pump PLEV shall be expressed with load weighting Pump PLEV = 1 / (0.01/A+0.42/B+0.45/C+0.12/D) where

.1 A= Pump Efficiency at 100%B= Pump Efficiency at 75%

.2 C= Pump Efficiency at 50%D= Pump Efficiency at 25%

.3 Actual job specific load profile weighting may be substituted for standard IPLVweighting

.9 Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

.10 Submittals that are "rejected" as being "non-compliant" will be re-reviewed once with all time for subsequent reviews back charged to the contractor in accordance with theengineer's current prevailing rate schedule. If a rate schedule for additional services is included, as part of the contract with the owner that rate schedule shall be used in lieu of the "current prevailing" rate schedule.

1.4. QUALITY ASSURANCE

.1 All equipment or components of this specification section shall meet or exceed therequirements and quality of the items herein specified, or as denoted on the drawings.

.2 Ensure pump operation, at specified system fluid temperatures without vapor bindingand 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 manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment with a minimum of 20 years experience.

.5 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 befor 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.

1.5. DESIGN CRITERIA

.1 The drawings indicate sizes, profiles, connections and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design intent and performance as judged by the engineer. The burden of proof for equality is on the proposer.

1.6. 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 liftinglugs if required for handling. Materials damaged by the elements should be packagedin such a matter that they could withstand short-term exposure to the elements duringtransportation.

.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.

.4 All scratched, dented, and otherwise damaged units shall be repaired or replaced asdirected by the Architect Engineer.

1.7. WARRANTY

.1 Provide a minimum One (1) year warranty on materials and installation under provision of Section 01 78 00

1.8. OPERATION AND MAINTENANCE MANUALS

.1 As a minimum, the Operation and Maintenance Manual shall include:

.1 Installation procedures including lifting, installation, piping and storage

.2 Operating instructions with start-up and shut down procedure

.3 Maintenance procedures with instructions

2 PRODUCTS

2.1. MANUFACTURERS

.1 Acceptable manufacturers shall be subject to compliance with the requirements.

.2 Contractor shall furnish and install new close-coupled vertical inline pump for chilled water and glycol loop systems as indicated on the drawings. Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Pump substitutions shall be provided with connection sizes equal to those scheduled. Pump substitutions shall not be provided at efficiencies less than those scheduled.

2.2. DESCRIPTION

.1 Single stage, single suction type, vertical inline design pump

.1 Glycol pumps: Constant speed with soft starter

.2 Chiller pumps: Separate VFDs supplied by mechanicals installed by the electrical contractor.

.2 Seals: Close-coupled serviceable without disturbing piping connections.

.3 Include casing drain plug and 1/4-inch suction and discharge gauge ports

2.3. COMPONENTS

.1 The pumps shall be close-coupled, inline for vertical or horizontal installation, in cast iron stainless steel 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 shallnot be de-rated at temperatures up to 250°F. The pump internals shall be capable ofbeing serviced without disturbing piping connections.

.2 As an option an EPR/Carbon/Tungsten/Carbide/SS seal (250°F maximum operatingtemperature), FKM/Carbon/Ceramic/SS seal, or EPR-Silicon Carbide/Silicon Carbide/SS 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 theseal.

.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 installedin 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 bronze or stainless steel impeller. Impeller shall be hydraulically and dynamically balanced to Hydraulic Institute Standards ANSI/HI 9.6.4.-2016. Theallowable residual imbalance conforms to ANSI grade G6.3, keyed to the shaft and secured by a stainless steel locking capscrew 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 175PSIG 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.

.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 followingoptional tests: Certified Lab tests (unwitnessed), Hydraulic Institute Level B tests, or Witnessed Tests.

2.4. ACCESSORIES

.1 Where noted on the schedule, provide one mechanical seal for each model type ofprimary pump.

.2 Where noted on schedule a Bell & Gossett Sediment Separator shall be furnished forinstallation on the flushing line between the pump discharge flange and the seal area.The sediment separator is installed to increase the overall life expectancy of the seal on inherently dirty systems. The separator shall remove dissolved solids from the flushing medium before the fluid enters the seal area where it can damage and shorten the life of the seal.

2.5. PUMP MOTOR AND CONTROLS PROTECTION

.1 Include protection as follows:

.1 Motor phase to phase fault.

.2 Motor phase to ground fault.

.3 Loss of supply phase.

.4 Over voltage.

.5 Under voltage.

.6 Motor over temperature.

.7 Inverter overload.

.8 Over current

.2 Ensure controls run automatic motor adaptation (AMA) for superior motor protection and control.

2.6. PIPEWORK, PUMPS, AND HYDRONIC SPECIALTIES:

.1 Fabrication:

.1 When connecting pipe to installed equipment connect pipe in accordance with manufacturer's instructions unless otherwise indicated. Use valves and flanges for isolation and ease of maintenance and assembly.

.2 Provide manufacturer’s recommended clearances around all systems, equipment and components for observation of operation, inspection, servicing and maintenance. Provide space for dissemble and removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment and components.

.3 Install piping to facilitate drainage and/or condensate management. Install drain valves at low points in piping systems, at equipment and at section isolating valves. Provide drain valve at each drain locator. Discharge to be visible. Drain valves shall be NPS ¾ ball valves with hose end male thread, cap and chain.

.4 Provide the pipe work with necessary connection points for expansion tanks, temperature probe and gauge connection and automatic air vents at high points in each piping systems. Install drain piping and terminate where discharge is visible.

.5 Assemble piping using fittings manufactured to ANSI standards.

.2 Pipe Welding:

.1 Welding to be in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.

.2 Hydrostatically test chilled glycol and steam pipework to pressures of 100 psi and maintain specified test pressure without loss for twelve (12) hours minimum. Ensure that equipment and other parts, which are not designed to withstand test pressure, are isolated prior to tests.

.3 Defects causing rejection shall be as described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code. Re-inspect and re-test repaired or re-worked welds.

.4 Pipe Supports:

.1 Pipework up to and including 8”: Pipe saddle mounted on top of HSS steel member using Heavy Series Pipe Clamps mounted horizontal, above cross members

.2 Pipework greater than 8”: U-Bolt or pipe saddle mounted on top of HSS steel member or hung from HSS steel member with double hangers. Example Anvil pipe support system.

.3 Pipe supports will be located to ensure a maximum pipe and support deflection.

.4 For HW packages, oversized pipe clamps must allow for pipe insulation on site.

.5 Pipe clips for copper pipe should be brass.

.6 Pipe clips for small-bore steel piping, above 2 1/2” should be malleable iron.

.7 Pipe supports shall be Heavy Series Pipe Clamps to support systems and pipework under all conditions of operation and prevent excessive stresses and vibration from being introduced into pipework or connected equipment.

.8 Shop fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

.9 Provide removable angle iron blocking and bracing to prevent movement of pipe work and equipment during shipping.

.5 Valves:

.1 All valves shall be of a single manufacturer. Install rising stem valves in upright position with stem above horizontal.

.2 Butterfly ISOLATION VALVES (MANUAL) (PIPE SIZE ABOVE 2”):

.1 Butterfly valves 6” and smaller are of lever operated type;

.2 Butterfly valves 8” and larger are of hand-wheel gear operated type.

.3 Sufficient space to be designed between the valve and other equipment to allow the valve to fully open and close. Valve lever or gear to be oriented to allow for easy access to open/close the valve by the operator.

.4 All valves located above 6ft, shall be oriented so that valve hand-wheel or lever can be equipped with chain-wheel operator.

.6 Paint:

.1 General:

.1 All piping, frame assembly and exteriors are to be factory painted.

.2 Paint shall be applied and allowed to dry for a sufficient amount of time before shipping.

.2 Product:

.1 The paint shall be a non-isocyanate enamel that produces a durable, chemically resistant coating similar to urethane.

.2 The vehicle type shall be a cross linked acrylic with an oxygenated and aromatic hydrocarbon solvent.

.3 All surfaces shall be prepared with a zero-induction epoxy primer before applying.

.4 The primer vehicle shall be an epoxy polymide with a titanium dioxide pigment and oxygenated and aromatic hydrocarbon.

.5 The two-part paint process shall be applied to all equipment and pipe spools before assembly.

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 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 5straight 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. Noless than the minimum recommended by the manufacturer.

.7 Provide an adequate number of isolation valves for service and maintenance of thesystem 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 andspecifications. 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 connectionsor 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.

3.3. FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Check power supply.

.2 Check starter protective devices.

.2 Start-up, check for proper and safe operation.

.3 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.

.4 Adjust flow from water-cooled bearings.

.5 Adjust impeller shaft stuffing boxes, packing glands.

3.4. START-UP

.1 General:

.1 In accordance with Section 01 91 00 – Commissioning, supplemented as specified herein.

.2 Provide manufacturer start up and commissioning.

3.5. PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic pump installation.

3.6. REPORTS

.1 In accordance with Sections 01 91 00 - Commissioning and Section 01 91.13.13 – Commissioning Plan, supplemented as specified.

3.7. TRAINING

.1 In accordance with Section 01 79 00.13 - Demonstration and Training for Building Commissioning: Training of O&M Personnel, supplemented as specified.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 23 05 00 - Common Work Results for HVAC.

1.2. REFERENCE STANDARDS

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-[2013].

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3. 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 HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4. CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section [01 78 00- Closeout Submittals].

.2 Operation and Maintenance Data: submit operation and maintenance data for HVAC water treatment systems for incorporation into manual.

1.5. DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 off ground in dry location indoors, in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect HVAC water treatment systems from nicks, scratches, and blemishes].

.3 Replace defective or damaged materials with new.

.4 Develop [Construction Waste Management Plan] [Waste Reduction Workplan] related to Work of this Section.

.5 Packaging Waste Management: remove for reuse [and return] [by manufacturer] of [crates,] [packaging materials] [pallets,] [padding,] as specified in [Construction Waste Management Plan] [Waste Reduction Workplan] in accordance with Section [01 74 19- Waste Management and Disposal.

2 PRODUCTS

2.1. GENERAL

.1 Water treatment program listed here should meet or exceed the water quality requirement of equipment manufacturers including the boilers, chillers, cooling towers, and pumps manufacturers.

2.2. MANUFACTURER

.1 Equipment, chemicals, and service provided by one supplier from HWDSB approved vendor listed below:

.1 Aquarian Chemicals,

Mauro Cesa

mcesa@aquarianchemicals.com

905-825-3711

.2 Vendor to select the equipment size not specifically provided in this section or the drawings to meet the required the system capacity and provide their calculations.

2.3. POT FEEDER

.1 Welded steel,

2.4. CHEMICAL FEED PIPING

.1 Resistant to chemicals employed.

2.5. CHEMICAL FEED PUMPS

.1 [Top-mounted] electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.

.2 Piston type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with stainless steel piston, pressure relief valve, double ball and check valves.

2.6. SHIPPING/FEEDING CHEMICAL CONTAINERS

.1 High density moulded polyethylene, with liquid level graduations, cover.

.2 Agitators: [_____]

.3 Stands: [_____]

2.7. CONDUCTIVITY CONTROLLER

.1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 microhms.

.2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleedoff status lights.

2.8. CONDUCTIVITY PROBES

.1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

2.9. WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 Hot water heating system: pot feeder, [25] L, operating pressure [_____]

.2 Chilled water system/Cooling tower loop: pot feeder, [25] L, operating pressure [_____]

.3 Glycol system: pot feeder, [25] L, operating pressure [_____]

.4 Micron filter for each pot feeder:

.1 Capacity 2% of pump recirculating rate at operating pressure.

.2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.10. WATER TREATMENT FOR STEAM SYSTEMS

.1 Performance: to control sludge, scale, dissolved solids, provide corrosion protection to following criteria:

.1 [_____]

.2 Chemical feed pump:

.1 Capacity: [_____][_____]

.2 One pump per [feed tank] [boiler].

.3 Chemical container:

.1 Containers: as specified.

.2 Capacity: [_____]

.3 Low water level cut-off and alarm.

.4 Agitator:

.1 Sized to suit container.

.2 With stainless steel shaft, stain-less steel impeller.

.3 Motor: [W] [HP].

.4 To suit installation.

.5 Chemical feed pump control:

.1 Repeat cycle percentage timer. Feed time fully adjustable for 0-100% of repeated time cycle, 30 minute repeat.

.2 Electric interlock with make-up water controls.

.3 Electric interlock with steam boiler feed pump.

.4 Reset timer initiated by signal from contact head metre installed on water make-up line to feed tank.

2.11. WATER TREATMENT FOR CONDENSER WATER SYSTEMS, SPRAY WATER SIDE OF CLOSED CIRCUIT COOLERS

.1 Chemical feed pump:

.1 Capacity: [_____][_____]

.2 To provide proportional chemical feed.

.2 Chemical container:

.1 As specified.

.2 Capacity: [_____]

.3 Bleed-off solenoid and throttling valves.

.4 Panel: EEMAC type [4] [5] [12] enclosure with enamel finish, pre-wired, following features:

.1 Internal wiring harness, colour-coded, identified, brought to central terminal board.

.2 Grounded AC receptacles for feed pumps and utility.

.3 Main power switch, indicating light, legend nameplate.

.4 Manual-auto selector switches, indicating lights for bleed-off control, chemical feed, with legend plates.

.5 Timers pulsed from water metre with contacting register to operate feed pumps [and bleed-off solenoid valve].

.6 Conductivity controller [with indicating metre] to control bleed-off.

.5 Flow assembly: consisting of conductivity probe mounted in flow-tee complete with isolating valves.

.6 Automatic flow switch: to shut down and re-start water treatment system on interruption of water flow.

.7 Make-up water metre:

.1 Capacity: [_____][_____]

.2 Size: NPS [_____]

.3 Bronze, capacity to meet requirements, non-reset electric cumulative totalizer, electric contacting register.

.8 Pot feeder:

.1 For addition of biocides.

.2 Capacity [_____] kPa max. WP.[1200]

2.12. CHEMICALS

.1 Provide [1] years supply.

.2 Obtain chemicals from manufacturer with existing valid contract with DND.

2.13. 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.

3 EXECUTION

3.1. EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC water treatment systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of [Departmental Representative] [Consultant] [DCC Representative].

.2 Inform [Departmental Representative] [DCC Representative] [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] [Departmental Representative] [DCC Representative]].

3.2. MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3. INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler and Pressure 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.

3.4. CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.5. CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by [DCC Representative] [Departmental Representative] [Consultant].

.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 system[s] 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 Disposal of cleaning solutions approved by authority having jurisdiction.

3.6. WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of [1 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 month.

.5 Provide necessary recording charts and log sheets for [1 year] operation.

.6 Provide necessary laboratory and technical assistance.

.7 Provide clear, concise, written instructions and advice to operating staff.

3.7. WATER SOFTENER

.1 Install in accordance with manufacturer's instructions.

.2 Install water metre in water softener inlet piping.

3.8. FIELD QUALITY CONTROL

.1 Start-up:

.1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning:

.1 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before TAB of connected systems.

.2 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 [initial] [raw] water analysis.

.4 Required quality of treated water.

.3 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 [Departmental Representative] [DCC Representative] [Consultant] in writing on matters regarding installed water treatment systems.

.4 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.

.5 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.

.6 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyze water in system.

.2 Based upon an assumed rate of loss approved by [Departmental Representative] [Consultant] [DCC Representative], establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.7 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.

.8 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.9 Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by [DCC Representative] [Consultant] [Departmental Representative].

.10 Demonstrations: Refer to commissioning specifications for training.

.11 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to [Departmental Representative] [Consultant] [DCC Representative].

3.9. CLEANING

.1 Progress Cleaning: clean in accordance with Section [01 74 00- Cleaning].

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section [01 74 00- Cleaning].

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART - 1 GENERAL

1.1 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.

.2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.

.3 With shop drawing/product data sheet submission, supply evidence that fire rated duct manufacturer is ULC listed to size requirements shows on drawings.

.4 Submit duct leakage test data prior to ductwork being covered from view.

.5 Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

1.2 CLOSEOUT SUBMITTALS

.1 Submit proper installation certification from fire rated duct manufacturer as specified in Part 3 of this section.

.2 Submit a site inspection and start-up report from fan filter diffuser manufacturer's representative as specified in Part 3 of this section.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Supply and hand to Owner at Substantial Performance of the Work, a minimum of 10 identified (with tags) grille/diffuser volume control damper adjustment keys.

1.4 QUALITY ASSURANCE

.1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

PART - 2 PRODUCTS

2.1 GALVANIZED STEEL DUCTWORK

.1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.

.2 Rectangular

.1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 Round

.1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings

.2 Gym ductwork: Factory finished white round ductwork in the gymnasium where it is exposed.

.4 Flat Oval

.1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.2 RECTANGULAR ALUMINUM DUCTWORK

.1 Alloy 3003 Temper H14 aluminum, ASTM B209, shop or factory fabricated, water-tight, with metal gauges and fabrication in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct working pressure classification, and type 316 stainless steel support hardware.

2.3 ROUND ALUMINUM DUCTWORK

.1 Alloy 3003 Temper H14 aluminum, ASTM B209, factory fabricated, water-tight, smooth interior, single wall duct, and fittings of spiral lockseam construction with site sealed beaded sleeve (slip type) joints, all in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct working pressure classification, and type 316 stainless steel sheet metal screws and support hardware.

2.4 FLEXIBLE METALLIC DUCTWORK

.1 Bare

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.

.2 Insulated

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-½") thick, 12 kg/m3 (0.75 lb/ft³) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC-S102.

2.5 FLEXIBLE FABRIC DUCTWORK

.1 Equal to DuctSox Corp. round fabric air duct, 25/50 flame spread/smoke developed rated when tested in accordance with CAN/ULC-S102, white or coloured (to manufacturer’s standards), and complete with 3 x 1 tension cable suspension system.

2.6 FLEXIBLE FABRIC DUCTWORK

.1 Bare

.1 Equal to Flexmaster Canada Ltd. "Fabriflex" Type 4 ULC listed and labelled Class 1 flexible fabric duct consisting of vinyl coated fibreglass cloth mechanically bonded to a corrosion resistant galvanized steel helix.

.2 Insulated

.1 Equal to Flexmaster Canada Ltd. "Fabriflex" Type 4T ULC listed and labelled Class 1 flexible fabric duct consisting of vinyl coated fibreglass cloth mechanically bonded to a corrosion resistant galvanized steel helix and factory insulated with 25 mm (1") thick glass fibre insulation with a polyethylene vapour barrier jacket.

2.7 FLEXIBLE CONNECTION MATERIAL

.1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber.

.2 Manufacturers:

.1 Duro Dyne Canada Inc. "DUROLON";

.2 Dyn Air Inc. "HYPALON".

.3 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber.

.4 Manufacturers:

.1 Duro-Dyne Canada Inc. "THERMAFAB";

.2 Dyn Air Inc. "SILICON HI-T".

2.8 METAL DUCT SYSTEM JOINT SEALANT

.1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.

.2 Manufacturers:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.9 ACOUSTIC LINING

.1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.

.2 Manufacturers:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.10 KITCHEN EXHAUST DUCT EXPANSION JOINT

.1 Hyspan Precision Products Inc. Series 2500 flanged, carbon steel, rectangular expansion joints sized to suit ductwork.

2.11 UNINSULATED KITCHEN GREASE EXHAUST DUCT

.1 Minimum #16 gauge black sheet steel liquid-tight ductwork with welded joints or listed in accordance with CAN/ULC S662.

.2 Grease-tight access doors in accordance with requirements of NFPA 96, constructed of same material as duct and as large as possible, up to 600 mm (24") in any dimension, located in the sides of the duct for ease of inspection and cleaning at each change in duct direction, at not less than 3 m (10') in straight duct including risers, and not less than 40 mm (1-½") from bottom of duct.

2.12 FACTORY INSULATED ROUND KITCHEN GREASE EXHAUST DUCT

.1 Equal to Selkirk ZeroClear kitchen exhaust duct, 2 hour fire rated to UL 2221, constructed, listed and labelled to UL/ULC 1978, and meeting requirements of NFPA 96. Duct is constructed of a type 304 stainless steel inner liner, 75 mm (3") of high temperature fibre insulation, and a stainless steel outer jacket, and is complete with all required fittings and accessories, including access and cleanout fittings where required.

2.13 FACTORY INSULATED RECTANGULAR/SQUARE KITCHEN GREASE EXHAUST DUCT

.1 Equal to DuraSystems "DuraDuct KEX" kitchen exhaust duct, 2 hour rated kitchen exhaust listed and labelled to CAN/ULC S144, and meeting requirements of NFPA 96. Prefabricated companion flanged duct sections providing a two-hour fire resistance with a zero clearance fire resistance rating in accordance with ASTM E2336. Duct is constructed of minimum #16 gauge black sheet steel inner liner, high temperature fibre insulation and a minimum #24 gauge galvanized steel outer jacket, and complete with required fittings and accessories, including access and cleanout fittings where required. Factory-fabricated grease duct assembly is to not require additional wraps or enclosures to achieve required fire resistance rating.

2 System shall be designed to provide access for inspection and cleaning of each change of duct direction and permit drainage of grease residue through a duct section.

a. Provide zero clearance, ASTM E2336 and UL 1978 or CAN/ULC S662 listed access doors for cleanout to maintain 2 hour fire rating and install in accordance with local requirements.

b. Access Doors shall be labeled “ACCESS PANEL – DO NOT OBSTRUCT”.

2.14 FACTORY INSULATED FIRE RATED DUCTWORK

.1 Equal to DuraSystems Barriers Inc. "DuraDuct HP" or "DuraDuct GNX" duct, 2 hour fire rated, constructed, ULC listed and labelled for fire rated ventilation applications. Duct is constructed of a galvanized steel inner liner, a galvanized steel outer jacket, and all required fittings and accessories, including support hardware.

2.15 IN-SLAB EXHAUST DUCTWORK

.1 Equal to ECCO Manufacturing "ECCODUCT" spiral wound, galvanized steel, 300 mm x 45 mm (12" x 1-¾") rectangular duct supplied in 3 m (10') lengths complete with factory supplied galvanized steel connection couplers, fittings, exterior discharges with back draft dampers, and support brackets. Concrete encased duct and fittings are 3 hour fire rated in accordance with tests conducted by Intertek/Warnock Hersey in accordance with ULC S115 and ASTM E814, are to have an impact loading rating of 200 kg (440 lb) from 1.5 m (5') with no permanent deformations in accordance with CAN3-A23, and are to have a point loading rating with 1 mm (1/32") permanent deformation when tested to CSA S269.1.

2.16 CASING AND PLENUM MATERIAL AND ACCESSORIES

.1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.

.2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.17 ACOUSTIC PLENUM PANELS

.1 Vibro-Acoustics Ltd. type "AP", 100 mm (4") thick panels with acoustic media meeting NFPA 90A requirements sandwiched between minimum #24 gauge galvanized sheet steel, with airside face perforated, access doors where shown, and with acoustic performance as follows:

Octave Bands, (Hz)	125	250	500	1000	2000	4000
Transmission Loss	21	28	39	50	53	56
Absorption Coefficient	0.7	0.9	0.99	0.99	0.9	0.9

.2 Manufacturers:

.1 Vibro-Acoustics Ltd.;

.2 Kinetics Noise Control Inc.;

.3 Carrier Corp. – Racan;

.4 Haakon Industries;

.5 Price Industries Inc;

.6 Alumavent.

2.18 PLENUM ACCESS DOORS

.1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.19 ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.20 SPLITTER DAMPERS

.1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.21 AIR TURNING VANES

.1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.22 MANUAL BALANCING (VOLUME) DAMPERS

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:

.1 hexagonal or square shaft extension through frame;

.2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;

.3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;

.4 linkage for multiple blade dampers;

.5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.

.2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.

.3 Round Dampers: Nailor Industries Inc. model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.

.4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.

.5 Manufacturers:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.23 BACKDRAFT DAMPERS

.1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:

.1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;

.2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;

.3 corrosion-resistant synthetic bearings;

.4 adjustable plated steel counterweights mounted internally in the airstream;

.5 concealed blade linkage located out of the airstream.

.2 Manufacturers:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.24 FUSIBLE LINK DAMPERS

.1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to CAN/ULC S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1-1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.

.2 Fusible link dampers are to be Type "B" or Type "C" (as required) with folded curtain blade out of air stream except where damper size or location requires use of type "A" dampers with curtain blade in air stream.

.3 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

.4 Manufacturers:

.1 Nailor Industries Inc.;

.2 Greenheck Fan Corp.;

.3 NCA Manufacturing Ltd.;

.4 Ruskin Co.;

.5 Price Industries (E.H. Price).

2.25 COMBINATION FIRE/SMOKE DAMPERS

.1 Nailor Industries Series 1221, ULC listed to CAN/ULC S112 and CAN/ULC S112.1, meeting requirements of NFPA 80, 90A, 92, 101 and 105, consisting of type A, B, or C fusible link fire dampers as required and a fail-safe, opposed blade, normally closed, motor operated smoke damper complete with factory installed and tested 120 V electric actuator.

.2 ULC 1-1/2 hour fire rated and ULC Class I leakage rated for smoke, and equipped with a 74°C (165°F) ULC classified fusible link that will cause damper to close and lock independent of actuator when duct temperature reaches maximum temperature of damper assembly.

.3 Supply damper with factory installed sleeves of minimum 400 mm (16") length, field verified by contractor dependent on wall thickness. Caulk sleeves to ULC requirements and constructed of 20 gauge for sizes up to 2.1 m (84") wide and 18 gauge for sizes greater than 2.1 m (84") wide.

.4 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

.5 Manufacturers:

.1 Nailor Industries Inc.;

.2 Greenheck Fan Corp.;

.3 NCA Manufacturing Ltd.;

.4 Ruskin Co.;

.5 Price Industries (E.H. Price).

2.26 SMOKE DAMPERS

.1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) smoke dampers, ULC classified to CAN/ULC S112.1, ULC Class I leakage rated for smoke, meeting requirements of NFPA 90A, 92, 101 and 105, normally closed, low pressure drop design, dynamically tested, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the opening, and an electric actuator to automatically close damper upon receiving an external signal, and to automatically open damper when system is reset.

.2 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

.3 Manufacturers:

.1 Nailor Industries Inc.;

.2 Greenheck Fan Corp.;

.3 NCA Manufacturing Ltd.;

.4 Price Industries (E.H Price).

2.27 ROOF DUCT SUPPORTS

.1 Equal to PHP Systems Design Model PHP-D adjustable duct support assemblies sized to suit duct size, each assembly complete with injection moulded recycled plastic and carbon black bases and tubular hot dip galvanized steel framing.

2.28 PRESSURE RELIEF DOORS

.1 Greenheck model PRAD (positive) or VRAD (negative) pressure relief doors constructed of same material as duct or plenum they are associated with, each complete with a sealing gasket, special latches, cable assembly with spring to limit door opening to maximum 80° and factory set, field adjustable pressure relief magnet assembly.

.2 Size access doors to match requirements of system so pressure drop through open blow-out door at required flow rate will not exceed rated pressure of duct system.

.3 Manufacturers:

.1 Greenheck Fan Corp.;

.2 United Enertech.

2.29 DUCT ACCESS DOORS

.1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.30 DUCTWORK DRAIN POINTS

.1 Equal to Ductmate Canada Ltd. "Moisture Drain", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut, and cap.

2.31 INSTRUMENT TEST PORTS

.1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.32 WIRE MESH (BIRDSCREEN)

.1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.33 LOUVRES

.1 Price Industries Inc. DE439 or DE635, 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, louvres sized as indicated on drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm (½")

mesh aluminum birdscreen in an aluminum frame.

2.34 LOUVRE BLANK-OFF PANELS

.1 Insulated, framed, sandwich construction panels consisting of 40 mm (1-½") thick rigid insulation (meeting NFPA 90A requirements) between minimum #20 gauge galvanized sheet steel with exterior face of panels finished to match finish of exterior wall louvres.

2.35 BRICK AND BLOCK VENTS

.1 Equal to Price Industries Inc. vents constructed of 6063-T5 alloy extruded aluminum, sized as shown, complete with stainless steel fasteners, aluminum rod vertical supports on minimum 300 mm (12") centres, #2 mesh fixed aluminum screen, and all required accessories to suit the application.

.2 Vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from manufacturer's standard colour range.

2.36 FIRE STOP FLAPS AND THERMAL BLANKET MATERIAL

.1 Rectangular or round, ULC listed and labelled, blade type galvanized steel fire stop flaps in accordance with CAN/ULC S112, Standard Methods of Fire Test of Fire-Damper Assemblies and CAN/ULC S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies, each complete with #22 gauge G60 galvanized steel blade(s) and frame, a 74°C (165°F) fusible link, and, for dampers 300 mm (12") and larger, ceramic fibre insulation on both sides of the blades.

.2 Ceramic fibre material in accordance with 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102 and of a thickness to suit required fire rating.

2.37 GRILLES AND DIFFUSERS

.1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.

.2 Manufacturers:

.1 Price Industries Inc.;

.2 Krueger Division of Air System Components Inc.;

.3 Titus;

.4 Nailor Industries Inc.;

.5 Tuttle & Bailey.

.6 diffuser face: perforated, laminar flow face constructed of aluminum with quarter-turn fasteners for removal and access to fan-motor and filter;

.7 mounting gasket: roll type gasket material supplied with units for site installation on T-bar ceiling members;

.8 factory secured seismic restraint connection hardware.

2.38 ROUND LOW SILHOUETTE ROOF MOUNTED VENTILATORS

.1 Spun aluminium, round, gravity roof mounting hoods in accordance with drawing schedule, each complete with:

.1 wind band with a rolled bead, and curb cap with one-piece, spun, deep venturi inlet, and pre-punched holes for mounting;

.2 galvanized steel bird screen;

.3 minimum 300 mm (12") high welded aluminium, insulated roof mounting curb with damper tray;

.4 aluminium backdraft damper supplied loose, for site installation in roof curb damper tray;

.5 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit control voltage requirements;

.6 aluminium backdraft damper supplied loose, for site installation in roof curb damper tray;

.7 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit site control voltage requirements;

2.39 HOODED TYPE VENTILATORS

.1 Low silhouette, rectangular, roof mounting hooded penthouse type ventilators in accordance with drawing schedule, each constructed of aluminium, supplied in knock-down form for site assembly, and each complete with:

.1 full 360° perimeter hood opening;

.2 12 mm x 12 mm (½" x ½") aluminium mesh bird screen;

.3 welded aluminium, minimum 300 mm (12") high insulated roof mounting curb with damper tray and curb seal;

.4 aluminium backdraft damper supplied loose for site installation in roof curb damper tray;

.5 non-corrosive motorized damper supplied loose for site installation in roof curb damper tray, equal to T. A. Morrison TAMCO Series 9000 insulated damper with linkage, end switch, and a Belimo or equal motor with voltage to suit site control voltage requirements;

2.40 INTAKE AND EXHAUST WALL BOX

.1 Equal to Reversomatic SWBLM wall boxes leakproof seamless construction, extruded aluminum grille, sized as shown, complete with stainless steel fasteners, neoprene backdraft damper, and all required accessories to suit the application.

.2 Vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from manufacturer’s standard colour range.

PART - 3 EXECUTION

3.1 CLEANLINESS REQUIREMENTS FOR HANDLING AND INSTALLATION OF DUCTWORK

.1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

.2 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.2 FABRICATION AND INSTALLATION OF GALVANIZED STEEL DUCTWORK

.1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.

.2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.

.3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken or beaded per SMACNA standards. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.

.4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.

.5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.

.6 Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

.7 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.

.8 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.

.9 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.

.10 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.

.11 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by the Consultant.

.12 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.

.13 The exposed duct hangers support assemblies for the gym area ductwork shall be factory finished white.

.14 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.

.15 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide drain points. Provide watertight ductwork for:

.1 ductwork outside building or otherwise exposed to the elements;

.2 dishwasher exhaust;

.3 shower exhaust ducts from grilles to duct main or riser;

.4 minimum of 3 m (10') upstream and downstream of duct mounted humidifiers or humidifier manifolds;

.5 fresh air intakes;

.6 wherever else shown.

.16 Leakage Testing:

.1 Ductwork leakage is not to exceed following:

.1 ductwork to 2" W.C. Class, 1% of total air quantity handled by respective fans;

.2 ductwork exceeding 2" W.C. Class, 2% of total air quantity handled by respective fans.

.2 Leakage testing is to be performed by the Testing, Adjusting and Balancing (TAB) agency in accordance with SMACNA HVAC Air Duct

Leakage Test Manual and is to be witnessed by the Consultant.

.3 Be responsible for following:

.1 preparing duct systems for leakage testing prior to installation of external insulation including capping duct runouts and provision of final tap-in for test equipment;

.2 schedule testing with TAB agency in advance, be present for all testing and ensure notice is given to the Consultant so they may witness testing;

.3 resealing and/or replacement of defective ductwork;

.4 bearing all costs associated with retesting ductwork which has failed to pass leakage testing.

.17 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.18 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.19 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.

.20 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.

3.3 INSTALLATION OF ALUMINUM DUCTWORK

.1 Provide aluminum ductwork, rectangular or round.

.2 Provide aluminium ductwork for:

.1 Not Appliable.

.3 Wherever bare aluminum ductwork comes in contact with ferrous metal or copper, paint ferrous metal or copper surface with a heavy, 100% covering coat of zinc chromate paint, asphalt paint or otherwise isolate direct contact with the bare aluminum.

.4 Refer to "Commentary on Aluminum Ducts" in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, do not use drive and S cleats for joining waterproof aluminum ductwork. Use following SMACNA joining methods:

.1 T-21 - welded flange;

.2 T-22 - companion angle and gasket;

.3 T-24A - flanged.

.5 Keep longitudinal joints at top surface of horizontal runs. Provide proper transverse supports to prevent deflection. Ensure duct is rigid.

.6 When mastic is used for sealing such as sealing longitudinal joints, apply mastic to both surfaces before they are mated. When dry, apply mastic again for a water-tight seal.

3.4 INSTALLATION OF STAINLESS STEEL DUCTWORK

.1 Provide stainless steel ductwork, round or rectangular.

.2 Provide stainless steel ductwork as follows:

.1 Kitchen Exhaust;

.3 Exposed stainless steel kitchen exhaust duct is to be minimum #16 gauge and of welded construction with pickled and passivated welds which are ground to a finish to match duct finish.

3.5 INSTALLATION OF FLEXIBLE DUCTWORK

.1 Provide maximum 1.8 m (6') fully stretched, long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.

.2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.

.3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.

.4 Do not penetrate fire barriers with flexible duct.

3.6 INSTALLATION OF ACOUSTIC LINING

.1 Provide acoustic lining in ductwork in locations as follows:

.1 wherever shown and/or specified on drawings;

.2 supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along duct and outward from box in all directions;

.3 all transfer air ducts.

.2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.7 INSTALLATION OF FIRE RATED DUCTWORK

.1 Provide 2 hour fire rated ductwork.

.2 Install ductwork in strict accordance with duct manufacturer’s instructions using support hardware supplied with duct.

.3 When installation is complete, arrange, and pay for duct manufacturer to visit site and examine duct installation. Make any revisions requested by manufacturer, and when manufacturer is satisfied with installation, obtain and submit a letter certifying proper installation in accordance with ULC requirements.

3.8 INSTALLATION OF SHEET STEEL KITCHEN GREASE EXHAUST DUCTWORK

.1 Provide welded sheet steel kitchen grease exhaust ductwork from exhaust hood(s) to roof mounted exhaust fans, all in accordance with requirements of NFPA 96. Construct ductwork watertight with continuous externally welded seams and joints, cleanouts, duct expansion provisions, riser residue traps, etc.

.2 Clean and prime coat ground welds in black steel ducts.

.3 Support ductwork at not greater than 1.5 m (5') intervals and ensure fasteners at hangers do not penetrate duct. Install without forming dips, sags, or traps where grease reside might collect, and locate access door/cleanouts for ease of maintenance.

.4 Slope horizontal ductwork 25 mm per 300 mm (1" per foot) back to exhaust hood.

.5 Installation shall be in strict accordance with the manufacturer's instructions and recommendations as well as the requirements of the cETLus listing.

.6 The entire kitchen exhaust duct system from the appliance to the termination shall be from one manufacturer.

.7 Use fire resistant duct hanging methods and systems in accordance with the manufacturer’s listings.

.8 Firestopping at fire separations:

.1 Listings to include firestopping procedures for the penetration of fire rated wall and floor assemblies.

3.9 INSTALLATION OF IN-SLAB DUCTWORK

.1 Provide in-slab concrete encased ductwork, complete with required fittings and accessories.

.2 Install duct with support brackets supplied with duct and coordinated with location of reinforcing steel, post tensioning cables, and any other structural slab component. Install duct in strict accordance with manufacturer’s installation instructions and requirements of the Consultant. Ensure all joints are water-tight.

.3 Confirm finish of exterior discharge fittings with the Consultant prior to ordering.

3.10 INSTALLATION OF CASINGS AND PLENUMS

.1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.

.2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems’ pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.

.3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.

3.11 INSTALLATION OF ACOUSTIC PANELS

.1 Provide acoustic panels for plenums. Integrate acoustic plenums with standard casings and plenums. Install acoustic panels in strict accordance with manufacturer's instructions. Seal panels with acoustic caulking where pipes, ducts or conduit penetrate and make air and watertight.

.2 Provide floor to ceiling high acoustic plenums where shown, each complete with required framing, including framing for access doors and other openings, each structurally designed to resist excessive deflection or bowing, constructed to be air-tight when subjected to a pressure differential of 2.48 kPa (0.36 psi), and designed so any one panel can be removed without dismantling entire plenum.

.3 Provide acoustic type access doors where shown, and provide acoustic caulking at all locations where acoustic plenums abut building walls or slabs, and at all points where pipe, ducts or conduit penetrate acoustic panels.

3.12 INSTALLATION OF CASING AND PLENUM ACCESS DOORS

.1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.

.2 Construct access doors to open in or out to suit positive and negative pressures of system.

.3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.

.4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.13 INSTALLATION OF ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.14 INSTALLATION OF SPLITTER DAMPERS

.1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.15 INSTALLATION OF TURNING VANES

.1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.16 INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

.1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.

.4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.17 INSTALLATION OF BACKDRAFT DAMPERS

.1 Provide backdraft dampers.

.2 Install and secure dampers so they cannot move or rattle.

3.18 INSTALLATION OF FUSIBLE LINK DAMPERS

.1 Provide fusible link dampers. Ensure damper rating (1-½ or 3 hr) is suitable for fire barrier it is associated with.

.2 Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer’s instructions and details, and Code requirements.

.3 Provide expansion clearance between damper or damper sleeve and opening in which damper is required. Ensure openings are properly sized and located, and all voids between damper sleeve and opening are properly sealed to maintain rating of fire barrier.

.4 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.19 INSTALLATION OF COMBINATION FIRE/SMOKE DAMPERS

.1 Provide combination fire/smoke dampers. Install dampers with retaining angles on all 4 sides of each side of damper, and, where required, connect with ductwork, all in accordance with damper manufacturer’s instructions and details, and Code requirements.

.2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

3.20 INSTALLATION OF SMOKE DAMPERS

.1 Provide smoke dampers. Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.

.2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

.3 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple smoke dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.21 INSTALLATION OF FLEXIBLE CONNECTION MATERIAL

.1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.

.2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.22 INSTALLATION OF ROOF MOUNTED DUCT SUPPORTS

.1 Supply supports for roof mounted ductwork.

.2 Hand adjustable structural supports to roofing trade on roof for installation and flashing into roof construction as part of roofing work. Accurately mark exact locations and spacing of structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

.3 Accurately mark location and spacing of roof support assemblies. At each plastic base location, carefully scrape away loose roof ballast (gravel) and all other debris and dirt. Prime existing membrane with a primer which is compatible with existing roofing components. Set bases in adhesive in accordance with manufacturer's installation instructions. Scrape loose ballast back around and on bases. Install framing, and install ductwork on the cross-members. Secure ductwork to cross-members with galvanized steel banding.

3.23 INSTALLATION OF PRESSURE RELIEF DOORS

.1 Provide pressure release access doors to prevent duct system explosion or implosion as a result of a duct obstruction, i.e. closed fire damper, which prevents normal air flow through the system. Size access doors in accordance with requirements of Part 2 of this section.

.2 Where pressure release doors are shown in suction ducts or plenums, mount access door assembly so door swings in and latch mechanism is on the inside of duct or plenum. If latch mechanism is not accessible, provide a standard access door at latch side of the pressure release access door for maintenance purposes.

.3 Adjust each latch mechanism by means of the adjusting pin to suit static

pressure of the particular system in accordance with latch mechanism manufacturer's instructions.

3.24 INSTALLATION OF DUCT ACCESS DOORS

.1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.

.3 When requested, submit a sample of proposed duct access doors for review.

.4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.25 INSTALLATION OF INSTRUMENTS TEST PORTS

.1 Provide instrument test ports in all main ducts at connections to fans, plenums, or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.

.2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.26 INSTALLATION OF WIRE MESH (BIRDSCREEN)

.1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.

.2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.27 INSTALLATION OF LOUVRES

.1 Provide louvres for wall openings.

.2 Install louvre assemblies and secure in place in accordance with manufacturer's instructions and details.

.3 Confirm exact louvre sizes and finish prior to ordering.

3.28 INSTALLATION OF LOUVRE BLANK-OFF PANELS

.1 Provide blank-off panels for inactive portions of exterior wall louvres.

.2 Secure panels in place with non-ferrous hardware so they cannot move or rattle, yet are easily removable.

.3 Confirm exact finish of panels prior to fabrication.

3.29 INSTALLATION OF BRICK AND BLOCK VENTS

.1 Supply brick or block vents for installation in exterior walls.

.2 Hand assemblies to masonry trade for installation.

.3 Accurately mark exact locations and coordinate installation.

3.30 INSTALLATION OF FIRE STOP FLAPS AND THERMAL BLANKETS

.1 Provide fire stop flaps in duct connection necks of grilles and diffusers installed in ULC fire rated suspended ceiling systems where shown on drawings.

.2 Provide thermal blanket material to completely cover grille and/or diffuser pans above suspended ULC fire rated ceilings. Cut, install, and secure in place in accordance with manufacturer's instructions and ULC requirements.

3.31 INSTALLATION OF GRILLES AND DIFFUSERS

.1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.

.2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.

.4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.

.5 Attach troffer type diffusers associated with typical ceiling mounted fluorescent lighting fixtures to the fixtures on floor prior to fixture installation in ceiling. When fixtures are installed, connect diffuser boots with flexible ductwork.

.6 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).

.7 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.

.8 Confirm grille and diffuser finishes prior to ordering.

3.32 SUPPLY OF DOOR GRILLES

.1 Supply door grilles as shown and scheduled.

.2 Hand grilles to appropriate trade at site for installation.

3.33 INSTALLATION OF ROOF MOUNTED GRAVITY VENTILATORS

.1 Provide roof mounted gravity ventilators.

.2 Supply a roof mounting curb with each ventilator and hand curbs to roofing trade on roof for mounting and flashing into roof construction as part of the roofing work. Site assemble gravity ventilators as required, and secure in place on curbs.

.3 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.

.4 Install dampers in curb damper tray and secure in place.

3.34 INSTALLATION OF INTAKE AND EXHAUST WALL BOXES

.1 Supply brick or block vents for installation in exterior walls.

.2 Hand assemblies to masonry trade for installation.

.3 Accurately mark exact locations and coordinate installation.

3.35 DUCT SYSTEM PROTECTION, CLEANING AND START-UP

.1 Temporarily cover all open ends of ducts during construction.

.2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.

.3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted, and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

END OF SECTION

1 GENERAL

1.1. SUBMITTALS

.1 **Shop Drawings/Product Data**: Submit shop drawings/product data sheets for all products specified in this Section. Shop drawings and product data sheets must confirm that the products proposed meet all requirements of the Contract Documents.

2 PRODUCTS

2.1. AIR TURNING VANES

.1 For square elbows - multiple-radius turning vanes, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same materialas the duct they are associated with, and in accordance with ANSI/SMACNA HVAC DuctConstruction Standards Metal and Flexible.

.2 For short branch ducts at grille and diffuser connections - air extractor type, each equippedwith a matching bottom operated 90 degree opposed blade volume control damper, constructed of the same material as the duct it is associated with and in accordance withrequirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal andFlexible.

2.2. MANUAL BALANCING (VOLUME) DAMPERS

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancingdampers, each constructed of the same material as the connecting ductwork unless otherwise specified, each designed to maintain the internal free area of the connecting duct, and each complete with:

.1 a hexagonal or square shaft extension through the frame;

.2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;

.3 blade stops for single blade dampers, designed to prevent the blade from movingmore than 90°;

.4 linkage for multiple blade dampers;

.5 a locking hand quadrant damper operator with, for insulated ducts 50 mm standoffmounting.

.2 **Rectangular Dampers:** Nailor Industries Inc. #SP1010 FF 16G LC BS NS, maximum size

.3 1.2 m x 1.2 m (4' x 4') for a single damper.

.4 **Multiple Rectangular Damper Section Assembly:** Rectangular assembly supplied withthe dampers or site constructed, of the same material as the damper and designed for tight and secure mounting of the individual dampers.

.5 Acceptable manufacturers are:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.3. FLEXIBLE CONNECTION MATERIAL

.1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber. Acceptable products are:

.1 Duro Dyne Canada Inc. "DUROLON";

.2 Dyn Air Inc. "HYPALON".

2.4. ROOF DUCT SUPPORTS

.1 Equal to Portable Pipe Hangers (Canada) Inc. Model PHP-D adjustable duct support assemblies sized to suit the duct size, each assembly complete with injection moulded recycled plastic and carbon black bases and tubular hot dip galvanized steel framing.

2.5. FAN AND DUCT SYSTEM EXPLOSION/IMPLOSION PREVENTION ACCESS DOORS

.1 McGill AirFlow Pressure-Relief (positive or negative) access doors constructed of the same material as the duct or plenum they are associated with, each complete with a sealing gasket, special latches, and cover with safety chain.

.2 Size access doors to match requirements of the system so that the pressure drop throughthe open blow-out door at the required flow rate will not exceed the rated pressure of theduct system.

.3 Acceptable manufacturers are:

.1 McGill AirFlow;

.2 United Enertech;

.3 Greenheck Fan Corp.

2.6. DUCT ACCESS DOORS

.1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for the purpose for which they are provided, and, unless otherwise specified, constructed of the same material as the duct they are associated with.

2.7. DUCTWORK DRAIN POINTS

.1 Equal to Ductmate Canada Ltd. "DUCTMATE MOISTURE DRAIN", 20 mm (¾") diametermoisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.8. MOTORIZED CONTROL DAMPERS

.1 T.A. Morrison & Co. Inc. "TAMCO", 100 mm (4") deep, flanged aluminum control damperswith AMCA certified maximum leakage through a 1.2 m x 1.2 m (4' x 4') damper of 52 L/s/m^2 (110 ft^3/min) against 1 kPa (0.145 psi) differential static pressure. Control dampersfor mixing applications are to be parallel blade type. Control dampers for open-shut serviceare to be opposed blade type.

.2 **Standard Damper:** Series 1000 dampers complete with:

.1 extruded 6063T5 aluminum frame and blades, each with an integral slot to receivea gasket;

.2 extruded silicone frame gaskets and extruded EPDM blade gaskets;

.3 slip-proof aluminum and corrosion resistant plated steel linkage concealed in the frame, equipped with self-sealing and self-lubricating bearings consisting of a Ticona "Celcon" inner bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.

.3 **Insulated Damper:** As specified for standard dampers but with all four sides of the framesinsulated with injected polyurethane foam, and with the blades thermally broken and insulated with expanded polyurethane foam.

.4 **Damper Motor:** Equal to Belimo CSA certified, spring return, direct coupled electric motordamper actuator, 120 volt or 24 volt as required, electronic overload protected, completewith position indicator, a housing to suit the mounting location, and additional features asrequired to suit the application and control sequence.

3 EXECUTION

3.1. INSTALLATION OF TURNING VANES

.1 Provide turning vanes in ductwork elbows wherever required, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.2. INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

.1 Provide manual balancing dampers in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install the dampers so that the operating mechanism is accessible and positioned for easyoperation, and so that the dampers cannot move or rattle. Ensure that operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.3 Where a duct for which a balancing damper is required has dimensions larger than the dimensions of the maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structuralsteel angle or channel framework which is properly sized. Seal to prevent air by-pass, andprovide connecting linkage.

.4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing five additional dampers at no additional cost.

3.3. INSTALLATION OF FLEXIBLE CONNECTION MATERIAL

.1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums,and/or easings connect to fans, and wherever else shown or specified.

.2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of the flexible fabric and to the fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure that connections to the flexible fabric material are arranged and supported so as to not imposeany external forces on the fabric.

3.4. INSTALLATION OF ROOF MOUNTED DUCT SUPPORTS

.1 Supply supports for roof mounted ductwork as indicated.

.2 Accurately mark the location and spacing of roof support assemblies. At each plastic baselocation, carefully scrape away loose roof ballast (gravel) and all other debris and dirt. Prime the existing membrane with a primer which is compatible with existing roofing components. Set bases in adhesive in accordance with the manufacturer’s installation instructions. Scrape loose ballast back around and on the bases. Install framing, and install ductwork on the cross-members. Secure ductwork to cross-members with galvanized steel banding.

3.5. INSTALLATION OF PRESSURE RELEASE DOORS

.1 Provide pressure release access doors where shown to prevent duct system explosion orimplosion as a result of a duct obstruction, i.e. closed fire damper, which prevents normalair flow through the system. Size access doors in accordance with requirements of Part 2of this Section.

.2 Where pressure release doors are shown in suction ducts or plenums, mount the accessdoor assembly so that the door swings in and the latch mechanisms is on the inside of theduct or plenum. If the latch mechanism is not accessible, provide a standard access doorat the latch side of the pressure release access door for maintenance purposes.

.3 Adjust each latch mechanism by means of the adjusting pin to suit the static pressure of the particular system in accordance with the latch mechanism manufacturer’s instructions.

3.6. INSTALLATION OF DUCT ACCESS DOORS

.1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirementsof ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure that the doors are properly located for damper maintenance.

.3 When requested, submit a sample of proposed duct access doors for review.

.4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce the ductwork to suit the access door installed.

3.7. INSTALLATION OF MOTORIZED CONTROL DAMPERS

.1 Provide motorized control dampers where shown. Secure in place to prevent movementor rattle, and to prevent air bypass around the damper.

.2 Provide insulated dampers in fresh air intake ductwork or openings, and for exhaust airservice at exterior walls.

.3 Equip each damper with an electric motor actuator, 120 volt or 24 volt as required. Ensurethat each actuator is equipped with all required features to suit the application.

3.8. CONTROL WIRING

.1 Provide all required power wiring for controls from 15A-1P circuits terminated in junction boxes adjacent to the control work, and do all control wiring to connect control components.

.2 Install wiring in conduit in accordance with electrical work wiring material and installation requirements.

END OF SECTION

1 GENERAL

1.1. REFERENCE STANDARDS

.1 All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.

.2 AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.

.3 AHRI 880 - Performance Rating of Air Terminals.

.4 AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

.5 ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.6 ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

.7 ASHRAE 130 - Methods of Testing for Rating Ducted Air Terminal Units.

.8 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.9 ASTM C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.10 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.11 ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.

.12 CSA C22.2 No. 236 – Heating and Cooling Equipment.

.13 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

.14 NFPA 70 - National Electrical Code.

.15 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

.16 UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

.17 UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.

.18 UL 1995 – Standards for Heating and Cooling Equipment.

1.2. ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section, and require attendance by all affected installers.

.2 Sequencing: Ensure that utility connections are achieved in an orderly and efficient manner.

1.3. SUBMITTALS

.1 Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate air flow, static pressure, NC designation, electrical characteristics, and connection requirements.

.2 Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

.1 Manufacturer shall include schedules listing discharge and radiated sound power level for each of the second through seventh octave bands (125 – 4000 Hertz) at specified differential static pressures.

.3 Manufacturer shall include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures from 1 to 4 inch water gauge.

.4 Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.

.5 Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.

.6 Project Record Documents shall record actual locations of units and controls

.7 Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

.8 Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.

1.4. QUALITY ASSURANCE

.1 Manufacturer Qualifications shall be specified in this section, with minimum ten years of documented experience.

.2 Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5. WARRANTY

.1 See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

.2 Provide 18 month manufacturer warranty from date of shipment for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

2 PRODUCTS

2.1. SINGLE-DUCT TERMINAL UNITS

.1 Basis of Design: Price Industries, Inc.

.1 Single-Duct Terminal Unit: SDV (direct digital controls).

.2 Quiet Single-Duct Terminal Unit: SDVQ (direct digital controls).

.3 Low Profile Single-Duct Terminal Unit: SDVLP (direct digital controls).

.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. Sound ratings of air distribution assemblies: Not to exceed ____ NC at ____ inlet static pressure, with a downstream static pressure of _____.

.2 Use attenuation values found in AHRI 885 Appendix E.

.3 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.

2.2. SINGLE-DUCT TERMINAL UNITS, STANDARD

.1 Description:

.1 Furnish and install Price model [SDV] single duct terminal units in the sizes and configurations as indicated on the plans.

.2 Unit Casing:

.1 The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.

.1 The casing shall be mechanically fastened.

.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.

.3 Unit discharge:

.1 Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

.4 Liners:

.1 Standard:

.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 (select one):

.1 1/2 inch thick, R-value of 2.1.

.2 1 inch thick, R-value of 4.1.

.5 Optional:

.1 Fiber-Free Foam Insulation - FF.

.1 Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have 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 thickness shall be (**select one**):

.1 1/2 inch thick, R-value of 2.0.

.2 1 inch thick, R-value of 4.0.

.2 Cleanroom Aluminum Foil Liner - CRAF.

.1 Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have 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 are sealed with metal endcaps and corner angles

.4 Insulation thickness shall be (select one):

.1 1 inch thick, R-value of 4.2.

.5 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 [left], [right], [top], or [bottom] 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.

.6 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.

.7 The airflow sensor shall maintain accuracy plus or minus five percent throughout terminal operating range even without 3 equivalent straight duct diameters per ASHRAE 130

.7 Inlet Valve - Standard:

.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.

.8 Options:

.1 Bottom Access Door:

.1 The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with (select one):

.1 Screws.

.2 Snap latches.

.3 Quarter turn sash latches.

.2 Hot Water Heating Coil:

.1 The hot water coil casing shall be constructed from a minimum 20 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 as [right hand] or [left hand] when looking into the coil inlet in the direction of airflow.

.3 The water coil shall be supplied with an access door located:

.1 Upstream of the water coil in the terminal casing.

.2 Downstream of the water coil in a common casing with the coil.

.4 The water coil access door shall be secured to the casing with Screws.

.1 Snap latches.

.2 Quarter turn sash latches.

.3 (select one):

.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 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.

.3 Electric Heating Coil:

.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 able to be flipped 180 degrees if necessary

.7 (Optional) The electric coils shall be provided with a non-fused door interlocking disconnect switch.

.8 (Optional) The electric coils shall be provided with a silicon-controlled rectifier (SCR) controller.

.9 (Optional) The electric coils shall be provided with insulation. Fiber free foam insulation not available.

.10 (Optional) The electric coils shall be provided with bottom mounted controls

.4 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 (ATT).

.2 Three foot discharge attenuator supplied as a separate piece (ATTSP).

.3 Five foot integral discharge attenuator (ATT5).

.4 Five foot discharge attenuator supplied as a separate piece (ATT5SP).

.5 Control Transformers:

.1 The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

.6 Certified Low Leakage Construction (CLL):

.1 The terminals shall be provided with factory certified low leakage construction up to six inches water gauge internal pressure.

.2 Inlet dampers shall exhibit leakage rates of less than 1% of maximum nominal catalog airflow

.3 Single duct casings shall exhibit external leakage rates of less than 1.5% of maximum nominal catalog airflow

.4 Terminals with low leakage construction shall include the following design features:

.1 The access door shall be supplied with compression style gasketing and quarter turn latches.

.2 The unit casing shall be flanged and gasketed at all external casing seams.

.3 All production units shall be individually factory tested to ensure compliance with project specific leakage requirements.

.4 Leakage test results shall be documented on a label affixed to each certified low leakage unit.

.5 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.

.6 Controls:

.1 See Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators for controls requirements.

.7 Controls Sequence:

.1 See Section 23 09 93 - Sequence of Operations for HVAC Controls for controls sequence requirements.

2.3. LOW PROFILE SINGLE-DUCT TERMINAL UNITS

.1 Description:

.1 Furnish and install Price model [SDVLP] single duct terminal units in the sizes and configurations as indicated on the plans.

.2 Unit Casing:

.1 The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.

.1 The casing shall be mechanically fastened.

.2 Low profile single-duct terminals units [SDVLP] shall have a maximum casing height of 10 inches.

.3 Unit Discharge:

.1 Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

.4 Liners:

.1 Standard:

.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 (select one):

.1 1/2 inch thick, R-value of 2.1.

.2 Optional:

.1 Fiber-Free Foam Insulation - FF.

.1 Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have 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 thickness shall be (select one):

.1 1/2 inch thick, R-value of 2.0.

.2 Foil Board Liner - FB.

.1 Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have 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 airstream shall be coated with NFPA 90A approved sealant.

.4 Insulation thickness shall be (select one):

.1 5/8 inch thick, R-value of 2.6.

.5 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 [left], [right], [top], or [bottom] 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 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.

.6 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.

.7 Inlet Valve – Low Profile:

.1 The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct for all units with inlet sizes four to eight inches in diameter. Inlets larger than eight inches in diameter shall be supplied as rectangular type inlets.

.2 Round inlet valves 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.

.8 Options as per VAV schedule:

.1 Bottom Access Door:

.1 The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with one of the followings:

.1 Snap latches.

.2 Quarter turn sash latches.

.2 Hot Water Heating Coil:

.1 The hot water coil casing shall be constructed from a minimum 20 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 as [right hand] or [left hand] when looking into the coil inlet in the direction of airflow.

.3 The water coil shall be supplied with an access door located:

.1 Upstream of the water coil in the terminal casing.

.2 Downstream of the water coil in a common casing with the coil.

.4 The water coil access door shall be secured to the casing with one of the followings:

.1 Snap latches.

.2 Quarter turn sash latches.

.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 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.

.3 Electric Heating Coil:

.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 able to be flipped 180 degrees if necessary

.7 (Optional) The electric coils shall be provided with a non-fused door interlocking disconnect switch.

.8 (Optional) The electric coils shall be provided with a silicon-controlled rectifier (SCR) controller.

.9 (Optional) The electric coils shall be provided with insulation. Fiber free foam insulation not available.

.4 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 (ATT).

.2 Three foot discharge attenuator supplied as a separate piece (ATTSP).

.3 Five foot integral discharge attenuator (ATT5).

.4 Five foot discharge attenuator supplied as a separate piece (ATT5SP).

.5 Control Transformers:

.1 The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

.6 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.

2.4. QUIET SINGLE-DUCT TERMINAL UNITS

.1 Description:

.1 Furnish and install Price model SDVQ quiet single duct terminal units in the sizes and configurations as indicated on the plans.

.2 Unit Casing:

.1 The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.

.1 The casing shall be mechanically fastened.

.3 Unit Discharge:

.1 Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

.4 Liners:

.1 Standard:

.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 (select one):

.1 1 inch thick, R-value of 4.1.

.2 Optional:

.1 Fiber-Free Foam Insulation - FF.

.1 Insulation shall comply with UL 181 erosion, mold growth and humidity requirements in accordance with ASHRAE 62.1, and shall have 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 thickness shall be (select one):

.1 1 inch thick, R-value of 4.0.

.2 Cleanroom Aluminum Foil Liner - CRAF.

.1 Insulation shall comply with UL 181 erosion, mold growth and humidity requirements in accordance with ASHRAE 62.1, and shall have 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 are sealed with metal endcaps and corner angles

.4 Insulation thickness shall be (select one):

.1 1 inch thick, R-value of 4.2.

.5 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 [left], [right], [top], or [bottom] 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 inches 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.

.6 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 The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range

.7 The airflow sensor shall maintain accuracy plus or minus five percent throughout terminal operating range even without 3 equivalent straight duct diameters per ASHRAE 130

.7 Inlet Valve - Standard:

.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.

.8 Options as per VAV schedule:

.1 Bottom Access Door:

.1 The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with (select one):

.1 Screws.

.2 Snap latches.

.3 Quarter turn sash latches.

.2 Hot Water Heating Coil:

.1 The hot water coil casing shall be constructed from a minimum 20 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 as [right hand] or [left hand] when looking into the coil inlet in the direction of airflow.

.3 The water coil shall be supplied with an access door located:

.1 Upstream of the water coil in the terminal casing.

.2 Downstream of the water coil in a common casing with the coil.

.4 The water coil access door shall be secured to the casing with (select one):

.1 Screws.

.2 Snap latches.

.3 Quarter turn sash latches.

.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 a 12 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.

.3 Electric Heating Coil:

.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 non-fused door interlocking disconnect switch.

.7 The electric coils shall be provided with a silicon-controlled rectifier (SCR) controller.

.8 The electric coils shall be provided with insulation. Fiber free foam insulation not available.

.4 Silencer:

.1 Construction:

.1 Casing shall be constructed of material that matches terminal unit casing and attach to terminal unit with slip and drive connection.

.2 Casing seams and joints shall be lock-formed and sealed, to provide leakage-resistant construction.

.3 Perforated steel shall be adequately stiffened to insure flatness and form. Rivets shall be painted as required.

.4 Internal baffles shall be provided with a radiused inlet and sloped tail.

.2 Principal Sound-Absorbing Mechanism:

.1 Packless (No-Media) Silencers:

.1 Models shall not contain absorptive media. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators.

.2 Absorptive (Dissipative) and Film Lined Silencers:

.1 Standard Acoustic media:

.1 Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data.

.2 Media shall be packed with a minimum of 15% compression during silencer assembly.

.3 Media shall be resilient such that it will not pull apart during normal applications, and shall resist settling, breakdown, and sagging from vibration. Media shall not rot, mildew, or otherwise deteriorate, and shall have sufficient flexibility to readily form around corners and curved surfaces.

.4 Media shall not cause or accelerate corrosion of aluminum or steel.

.5 Mineral wool is not permitted as a substitute for glass fiber.

.3 Media Protection:

.1 Dissipative silencers:

.1 Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.

.2 Film Lined silencers:

.1 The acoustic media shall be completely wrapped with polymer film to help prevent shedding, erosion and impregnation.

.2 The wrapped acoustic media shall be separated from the perforated metal by a factory-installed acoustically transparent spacer.

.3 The spacer shall be flame retardant and erosion resistant.

.4 Mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer.

.5 Silencer manufacturer shall provide a written test report showing silencer assemblies have Class 1 flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

.5 Control Transformers:

.1 The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

.9 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.

3 EXECUTION

3.1. EXAMINATION

.1 Verify that conditions are suitable for installation.

.2 Verify that field measurements are as shown on the drawings.

3.2. INSTALLATION

.1 Install the terminal units in accordance with the manufacturer's instructions.

.2 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.

.3 See drawings for the size(s) and duct location(s) of the air terminal units.

.4 Provide ceiling access doors or locate units above easily removable ceiling components.

.5 Support the terminal units individually from the structure.

.6 Embed anchors in concrete in accordance with ASTM E488/E488M.

.7 Do not support the terminal units from the ductwork.

.8 Connect the terminals to the ductwork in accordance with Section 23 31 00.

.9 Install heating coils in accordance with Section 23 82 00.

.10 Verify that electric power is available and of the correct characteristics.

3.3. ADJUSTING

.1 Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

3.4. FIELD QUALITY CONTROL

.1 See Section 01 40 00 - Quality Requirements, for additional quality requirements.

3.5. CLOSEOUT ACTIVITIES

.1 See Section 01 78 00 - Closeout Submittals for closeout submittals.

.2 See Section 01 79 00 - Demonstration and Training for additional closeout requirements.

END OF SECTION

1 GENERAL

1.1. RELATED WORK

.1 This Specification Section forms part of the Contract Documents and is to be read, interpreted and coordinated with other parts.

1.2. QUALITY ASSURANCE

.1 Catalogued or published ratings shall be those obtained from tests carried out by Manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

2 PRODUCTS

2.1. AIR TERMINALS

.1 General

.1 Grilles, registers and diffusers shall be product of one Manufacturer

.2 Refer to drawings for sizes and air quantities

.3 Refer to schedules on drawings for details

.4 Base air outlet application on space noise level of NC 30 maximum

.5 Air terminals shall be checked for compatibility with ceiling types. Refer to Architectural reflected ceiling plans

.6 Manufacturer (other than design listed) shall match performance data and indicate specific comparison for each item, with shop drawing submission

.7 Ceiling mounted air terminals shall be provided with means for attachment of two seismic security wires at opposite corners on each air terminal

.8 Provide concealed baffles, where necessary, to direct air away from walls, columns or other obstructions within radius of air terminal operation

.9 Provide auxiliary frames for diffusers located in drywall ceilings and grilles mounted in gypsum walls in public areas. In other areas grilles should be attached to ductwork, or flanged to outside of the opening

2.2. LOUVRES - MOTORIZED

.1 Extruded aluminum: frame depth 4”.

.2 Blades limited to 45° to horizontal in open position.

.3 Blades at 5” centres with up-turned rain stops on trailing edges.

.4 Concealed motor operator.

.5 Electric motor to be included (120/1/60).

.6 Baked enamel finish to Consultant choice

.7 Removable 16 gauge diameter aluminum wire bird screen with 1/2” mesh.

2.3. LOUVRES - STATIONARY

.1 General

.1 Extruded aluminum frames and blades with minimum 50% free area and weather proof.

.2 Welded construction with exposed joints ground flush and smooth or mechanically fastened with stainless steel fasteners

.3 Lower assembly sealed and water tight

.4 Removable 16 gauge diameter aluminum wire bird screen with 1/2” mesh. Bird screen mounted in 20 gauge thick aluminum folded frame. Frame to be installed inside louvre

.5 Factory applied baked enamel finish to Consultants colour choice

.6 Mill finish

.7 Anodized permanodic hard colour finish

3 EXECUTION

3.1. AIR TERMINALS

.1 Install with cadmium plated screws in counter sunk holes where fastenings are visible.

.2 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers.

.3 Refer to Architectural Reflected Ceiling plans for exact locations of air terminals.

.4 Paint ductwork behind grilles with matte black paint where duct or insulation surfaces are visible.

.5 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.

.6 Where air terminals are installed in mechanical grid ceiling, provide minimum two 12 gauge galvanized steel wire seismic security bridles at opposite corners of each air terminal and such that air terminal cannot fall.

.7 Hand over door grilles to General Contractor for installation.

3.2. LOUVRES

.1 Provide necessary flashing and counterflashing for louvres installed in walls.

.2 Caulk louvre and flashing and counterflashing to make installation water tight.

.3 Blank-off panels shall be constructed to SMACNA standards, minimum 20 gauge sandwich panel with 1” thick fibreglass insulation.

.4 Blank-off panels shall have painted flat black enamel finish.

END OF SECTION

1 GENERAL

1.1. GENERAL

.1 Section 23 05 00 – Common Work Results for HVAC.

1.2. SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles.

.2 Sustainable requirements for construction and verification.

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 independent 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 and Section 23 05 00 - Common Work Results for HVAC.

.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 Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC.

.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. REFERENCE STANDARDS (LATEST REVISIONS)

.1 ADC 1062GRD 84 Test Code for Grilles, Registers and Diffusers.

.2 ASHRAE 70 – Method of Testing the Performance of Air Outlets and Air Inlets

.3 ASTM 610 – Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces

.4 ASTM 714 – Test Method for Evaluating Degree of Blistering of Paints

.5 ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes

.6 ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

.7 ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

.8 NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems

.9 UL/ULC – Underwriters Laboratories Fire Resistance Directory/Underwriters Laboratories of Canada Equipment and Materials Directory, if applicable

1.6. MANUFACTURED ITEMS

.1 Grilles, registers and diffusers shall be product of one manufacturer for generic type, i.e. grilles and registers by one, diffusers by one, or same.

1.7. MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

1.8. CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

2 PRODUCTS

2.1. GENERAL

.1 Provide arrangement and type of grilles and diffusers in each space to achieve an Air Diffusion Performance Index (ADPI) of at least 80.

.2 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation and away from other supply diffusers and return grilles.

.3 Provide plaster frame for diffusers located in plaster and gypsum board surfaces.

.4 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.5 Paint the inside of all duct openings with black flat paint before installing diffusers or registers to it.

.6 Registers and diffusers will be installed in such a manner as to facilitate repeated removals without damaging ceiling or wall construction and finish

.7 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.8 Where grilles, registers and diffusers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A 2009 and required fire damper.

.9 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified.

.3 Concealed fasteners.

.4 Concealed manual volume control damper operators.

.10 Colour: As indicated on the schedule.

2.2. MANUFACTURED UNITS

.1 Basis of Design: Price Industries Inc. or Approved Equal.

2.3. ADJUSTABLE SQUARE CONE DIFFUSERS

.1 Description:

.1 Furnish and install Price model SCDA Steel adjustable square cone ceiling diffusers of sizes and mounting types designated by the plans and air distribution schedule.

.2 Construction:

.1 Diffusers shall be steel construction, and shall consist of a seamless, one-piece, precision formed backpan that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct and an outer frame which is recessed from the ceiling plane to allow for field adjustment of the airflow discharge from fully horizontal to fully vertical.

.2 The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit.

.3 An inner cone assembly shall consist of 3 cones or 4 cones (only on 600 x 600 mm) size which drop below the ceiling plane. The inner cone assembly shall be completely removable from the diffuser face to allow for full access to any dampers or other ductwork components located near the diffuser neck.

.4 Non-protrusive airflow directional tabs shall be provided on the back of the inner cones which may be positioned for either horizontal or vertical discharge.

.5 The diffuser ceiling module size shall be:

.1 600 x 600 millimeters

.2 500 x 500 millimeters

.3 300 x 300 millimeters

.3 Paint Specification:

.1 All components shall have a baked-on powder coat finish.

.1 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

.2 The paint film thickness shall be a minimum of 2.0 mils.

.3 The finish shall have a hardness of 2H.

.4 The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

.5 The finish shall have an impact resistance of 9.04 Newton meters.

.2 All components shall have a custom finish in a color to match a customer supplied sample.

.4 Mounting Frame:

.1 The diffuser mounting frame shall be suitable for lay-in or surface mount applications with the following frame style (select one):

.1 14.28 mm wide T-bar with drop frame

.2 Concealed spline

.3 23.81 mm wide flat T-bar

.4 Snap-in T-bar

.5 14.28 mm wide regular T-bar

.6 Clip-on Recessed Spline

.7 Surface mount

.5 Volume Control Damper:

.1 The diffuser shall be supplied with a steel volume control damper:

.1 Full flow damper, diffuser mounted (VCR8E)

.6 Options:

.1 Beaded Extended Neck:

.1 The diffuser shall be supplied with a beaded neck extended to a depth of 63.5 mm

2.4. LINEAR SLOT DIFFUSERS

.1 Manufacturer

.1 Basis of Design: Price Industries, Inc. or Approved Equal

.1 Slot Diffusers: Model SD

.2 Sloped Shoulder Slot Diffuser Plenum: Model SDA

.3 Straight Shoulder Slot Diffuser Plenum: Model SDB

.2 Slot Diffusers

.1 Description:

.1 Furnish and install Price model SD slot supply and return slot diffusers in sizes and capacities as shown by the plans and air distribution schedule.

.2 Provide drawings accompanied by an itemized list indicating the unit locations and appropriate product submittal drawings provided by the manufacturer. Exact dimensions of the walls and ceiling are per the architectural drawings.

.2 Performance:

.1 Performance of the selected slot diffusers shall be based on catalogued data obtained with the pattern controllers set in the normal operating position and a compatible Price supply air plenum and tested in accordance with ASHRAE 70.

.3 Paint Specifications:

.1 Baked-on powder coat finish.

.1 The paint film thickness shall be a minimum of 2 mils.

.2 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.

.3 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.

.4 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.

.5 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.

.2 All components shall have a custom finish in a color to match a customer supplied sample.

.3 The diffuser shall have an anodized finish.

.4 Options (as per diffuser schedule):

.1 Mitered Corners:

.1 The diffuser shall be supplied with inactive [90 degree] or [135 degree] mitered corner assemblies. The mitered corners shall be extruded aluminum construction, with an all welded, factory assembled miter, finished to match the associated straight sections of the slot diffuser.

.2 Blank off:

.1 The diffuser shall be supplied with [vinyl] or [metal] blank off sections. The blank-offs shall cover inactive sections of the slot diffuser, and shall be shipped loose for field cutting and installation.

.3 Alignment Strips:

.1 The diffuser shall include alignment strips when the diffuser is supplied in multiple sections to provide linear alignment to the continuous slot diffuser.

.2 Plaster Frame Spacers:

.1 The diffuser shall be supplied with plaster frame spacers to provide the correct spacing of the plaster frame prior to installation of the diffuser.

.2 Field Cut Diffusers:

.1 The diffuser shall be supplied six inches longer than specified to allow the diffuser to be cut to size in the field.

Field cutting shall be specified where a continuous run of diffuser is required, and where there may be a duct length variation.

.3 Equalizing Core:

.1 The diffuser shall be supplied with an equalizing core to equalize the air velocity over the face of the diffuser (standard with spiral duct frame)

.4 Construction:

.1 The diffusers shall have discharge slots & width as per the diffuser schedule.

.2 The supply diffusers shall have aerodynamically curved “ice-tong” shaped pattern controllers for 180-degree air pattern control and airflow dampering, if required.

.3 The return units shall match the supply units in appearance.

.4 The diffuser border shall be extruded aluminum construction with extruded aluminum spacers and mitered end flanges.

.5 Continuous length units shall be provided with factory assembled corner modules to suit drawings and site conditions. Splice plates and alignment plates shall be provided to align continuous slot assemblies. The maximum section length shall be 72 inches.

.6 The linear slot diffusers shall be compatible for Surface Mounting or T-bar lay in mounting with the following border style: Select based on Diffuser Schedule and Drawings, contractor to confirm border style based on site conditions:

.1 Flange frame, concealed mounting

.2 Flush fixture frame, concealed mounting

.3 Flush plaster frame, concealed mounting

.4 Flange plaster frame, concealed mounting

.5 Concealed Plaster frame

.6 Suspended ceiling, 3/4 inch frame

.7 Concealed spline

.8 Inverted T-bar, 15/16 inch lay-on frame

.9 Inverted T-bar, 9/16 inch lay-in flush face

.10 Curved face for spiral duct

.11 Narrow member T-bar, 9/16 inch x 5/16 inch width

.12 Techzone ceiling

.13 Techstyle ceiling.

2.5. ALUMINUM LOUVERED GRILLE

.1 Basis of Design: Price Industries, Inc. or Approved Equal

.1 Aluminum Louvered Supply Grille: Model 610 Singel Deflection, 620 Double Deflection.

.2 Aluminum Louvered Return Grille: Model 630, 635, 610Z

.3 Aluminum Louvered Filter Frame Return Grille 630FF or 635FF

2.6. ALUMINUM LOUVERED SUPPLY GRILLE

.1 Description:

.1 Furnish and install aluminum louvered supply grilles and registers of sizes and mounting types designated by the plans and air distribution schedule.

.2 Construction:

.1 Grilles shall be single deflection or double deflection louver type, and shall have:

.1 One set of fully adjustable blades, with 3/4 inch on center blade spacing (Model 610).

.2 Two sets of fully adjustable blades, with the second set behind the first set, and with 3/4 inch on center blade spacing (Model 620).

.2 The grilles front blade orientation shall be, as indicated on the outlet schedule.

.1 Front blades parallel to the long dimension.

.3 The blades and border shall be aluminum construction.

.4 The minimum grille size shall be 6 inches by 4 inches. The maximum one-piece grille size shall be 48 inches x 48 inches.

.3 Paint Specification:

.1 All components shall have a baked-on powder coat finish.

.1 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

.2 The paint film thickness shall be a minimum of 2.0 mils.

.3 The finish shall have a hardness of 2H.

.4 The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

.5 The finish shall have an impact resistance of 80 inch-pounds.

.6 All components shall have a custom finish in a color to match a customer supplied sample.

.4 Options:

.1 Opposed Blade Damper:

.1 The grille shall be supplied with a or galvanized steel (D) opposed blade damper.

.2 Border Style:

.1 The grille shall be suitable for sidewall mounting or T-bar lay-in mounting, complete with a border in the following style: (Select one based on schedule)

.1 1-1/4 inch flat border.

.2 1 inch narrow border.

.3 Mounting Frames:

.1 The grille shall be supplied with:

.1 3/8 inch flat border mounting frame.

.4 Fastening:

.1 The grille shall be supplied with the following fastening method (Select one based on schedule)

.1 Countersunk screw holes complete with Philips-head screws.

.2 No screw holes (default for T-bar installation).

.5 Insect Screen:

.1 The grille shall be supplied with an 18 x16 aluminum mesh insect screen. (Not be included when selected with Opposed Blade Damper)

2.7. ALUMINUM LOUVERED RETURN GRILLE

.1 Description:

.1 Furnish and install aluminum louvered return grilles and registers of sizes and mounting types designated by the plans and air distribution schedule.

.2 Construction:

.1 Grilles shall be 45 degree deflection fixed louver type, and shall have:

.1 One set of blades with 3/4 inch on center blade spacing [Model 630]

.2 One set of blades with 1/2 inch on center blade spacing [Model 635]

.3 One set of fixed blades with 0 degree deflection and 3/4 inch on center blade spacing [Model 610Z].

.2 The grilles front blade orientation shall be, as indicated on the outlet schedule.

.1 Front blades parallel to the long dimension.

.3 The blades and border shall be extruded aluminum construction.

.4 The minimum grille size shall be six inches by four inches.

.3 Paint Specification:

.1 All components shall have a baked-on powder coat finish.

.1 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

.2 The paint film thickness shall be a minimum of 2.0 mils.

.3 The finish shall have a hardness of 2H.

.4 The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

.5 The finish shall have an impact resistance of 80 inch-pounds.

.2 All components shall have a custom finish in a color to match a customer supplied sample.

.2 Options:

.1 Opposed Blade Damper:

.1 The register shall be supplied with a [coated aluminum (DAL)] or [galvanized steel (D)] opposed blade damper. The damper shall be operable from the register face. (Select one based on schedule)

.2 Border Style:

.1 The grille shall be suitable for surface mounting, T-bar lay-in mounting, panel mounting, complete with a border in the following style: (Select based on schedule)

.1 Surface Mount with 1-1/4 inch flat border.

.2 Surface Mount with 1 inch narrow border.

.3 Panel mount border for T-bar installation. The maximum grille size shall equal the module size minus four inches.

.3 Mounting Frames:

.1 The grille shall be supplied with (select one):

.1 A 3/8 inch flat border mounting frame.

.2 A 5/8 inch narrow border mounting frame.

.4 Fastening:

.1 The grille shall be supplied with the following fastening method: (Select based on schedule)

.1 Countersunk screw holes complete with screws.

.2 Concealed bracket (applies to Model 630 and surface mount only)

.3 No screw holes. (default for T-bar frames)

.5 Insect Screen:

.1 The grille shall be supplied with an 18 x16 aluminum mesh insect screen.

.6 Thin Line Return Dissipater (Nominal 22 x 22 inch size and Flat Face Border T-bar frame only):

.1 The grille shall be supplied with a Thin Line Return Dissipater (TLRD) to provide sound power insertion loss across the full range of frequencies, and shall be suitable for ceiling and wall applications.

.2 The manufacturer shall provide catalogued performance for insertion loss and transmission loss.

.3 The TLRD shall be a high-quality welded galvanized steel construction. Satin Coat paint shall be available as an option.

.4 The TLRD shall be factory-mounted to the grille and shipped as a one-piece construction to simplify field installation.

.7 Light Shield:

.1 The grille shall be supplied with a light shield to minimize the direct line of sight through the grille into the ceiling plenum and block reflected light from ceiling fixtures.

.8 Magnetic Resonance Imaging (MRI) Construction:

.1 The grille shall be supplied with an all-aluminum construction for MRI applications.

.2 The grille module shall be 24 x 24 inches with a [T-bar] **or** [Narrow member] frame style.

.3 The MRI option shall not include a volume control damper.

2.8. ALUMINUM LOUVERED FILTER FRAME RETURN GRILLE

.1 Description:

.1 Furnish and install aluminum louvered filter frame return grilles and registers of sizes and mounting types designated by the plans and air distribution schedule.

.2 Construction:

.1 Grilles shall be 45 degree deflection fixed louver type to minimize see-through, and shall have:

.1 One set of blades with 3/4 inch on center blade spacing (Model 630FF).

.2 One set of blades with 1/2 inch on center blade spacing (Model 635FF).

.2 The grilles front blade orientation shall be, as indicated on the outlet schedule.

.1 Front blades parallel to the long dimension.

.3 The blades and border shall be heavy extruded aluminum construction.

.4 The grille shall use a hinge and quarter turn quick-release fasteners for access.

.5 The filter frame shall accept two inch filter media, supplied by others.

.6 The minimum grille size shall be six inches by four inches. The maximum one-piece grille size shall be 48 inches x 48 inches.

.3 Paint Specification:

.1 All components shall have a baked-on powder coat finish.

.1 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

.2 The paint film thickness shall be a minimum of 2.0 mils.

.3 The finish shall have a hardness of 2H.

.4 The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

.5 The finish shall have an impact resistance of 80 inch-pounds.

.2 All components shall have a custom finish in a color to match a customer supplied sample.

.4 Options:

.1 Border Style:

.1 The grille shall be suitable for surface mounting, T-bar lay-in mounting, or panel mounting, complete with a border in the following style:

.1 1-1/4 inch flat border.

.2 Panel mount border for T-bar installation. The maximum grille size shall equal the module size minus four inches.

.2 Fastening:

.1 The grille shall be supplied with a 3/8 inch flat border mounting frame.

.1 A hinge-tab mechanism shall allow hinging or removal of the grille from the filter frame for cleaning. Hinge tab orientation shall be:

.1 Parallel to the long dimension.

.2 The grille shall be fixed with quarter turn fasteners on all four sides for removal of the grille from the filter frame to ease cleaning of the grille.

3 EXECUTION

3.1. EXAMINATION

.1 Verify that conditions are suitable for installation.

.2 Verify that field measurements are as shown on the drawings.

3.2. MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3. INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Install with stainless steel screws in countersunk holes where fastenings are visible.

.3 All diffusers in finished areas to have concealed mounting.

.4 Install and adjust air registers to provide noiseless and draftless distribution. Primary air balance to be done at duct dampers with final adjustment only at diffusers and grilles.

3.4. CLEANING

.1 Proceed 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

1 GENERAL

1.1. RELATED WORK

.1 This Specification Section forms part of the Contract Documents and is to be read, interpreted and coordinated with other parts.

2 PRODUCTS

2.1. MINI MAKE UP AIR UNIT

2.2.1 CONSTRUCTION

.1 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA/UL

2.2.2 HEATER

.1 Heating coils shall be of High Grade Nickel Chromium alloy and shall be insulated by fl oating ceramic bushings from the galvanized steel frame. Coil terminals shall be stainless steel, insulated by means of non –rotating ceramic bushings

2.2.3 SAFETY CONTROLS

.1 Hi-limit with damper shutdown and alarm

.2 Low-limit with damper shutdown and alarm

.3 High temperature automatic reset thermal cutout that will reset automatically after cool off

.4 Manual reset

2.2.4 STANDARD BUILT IN COMPONENTS

.1 Fan speed controller

.2 Duct Temperature sensor

.3 Fan

.4 Damper

.5 Washable fi lter

.6 Built in Electronic controller (SCR) - ON/OFF components will not be accepted

.7 Current sensor available on all units or Wall mounted push button fan control for models 100 cfm

2.2.5 AIR FLOW

.1 Built in Temperature Sensor controls the heater proportionally to maintain the pre-set air temperature in the duct

.2 Reversible mounting air fl ow capability

.3 Electronic Air Flow sensor available on models below 100 cfm, and a maximum kw's of 3kw on 240/1 or 2.5kw 208/1

2.2.6 SIZE AND CAPACITY

.1 Collar size, heater kw's, volts and phase, shall be as per Mini Make up Air schedule.

3 EXECUTION

3.1. INTERNAL WIRING

.1 All internal wiring shall terminate on clearly identifi ed terminal blocks.

.2 A wiring diagram shall be installed on the control box cover

.3 Prior to shipping, all units shall withstand tests as required by CSA/UL.

3.2. MOUNTING METHOD

.1 Unit must have inlet/outlet collars to accommodate job requirement

.2 The unit shall have hanger brackets designed to be used with threaded rod.Spring isolators or other means, may be added to the rods to reduce vibration

3.3. APPROVALS

.1 Mini Make up Air data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval prior to manufacturing.

END OF SECTION

1 GENERAL

1.1. REFERENCES

1. ANSI/AHRI Standard 920 (I-P) 2020 - “Performance Rating of Direct-Expansion Dedicated Outdoor Air System Units”
2. ANSI/ASHRAE 15-2019 - “Safety Standard for Refrigeration Systems”
3. ANSI/ASHRAE/IES 90.1-2022 – “Energy Standard for New Buildings Except Low-Rise Residential Buildings”
4. Safety of Household And Similar Electrical Appliances, Part 1: General Requirements [UL60335-1:2016 Ed.6] and [CSA C22.2#60335-1:2016 Ed.2]
5. Household and Similar Electrical Appliances – Safety - Part 2 - 40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners, and Dehumidifiers [UL 60335-2-40:2022 Ed.4] and [CSA C22.2#60335-2-40:2022 Ed.4]
6. ANSI Z83.4-2017/CSA 3.7-2017 – “Non-recirculating direct gas-fired heating and forced ventilation appliances for commercial and industrial application”; ANSI Z83.8-2016/ CSA 2.6-2016 – “Gas unit heaters, gas packaged heaters, gas utility heaters, and gas-fired duct furnaces”
7. ANSI/NFPA 70 - National Electric Code (2008 – 2023, varies by State)
8. International Fuel Gas Code (2021)
9. NFPA 90 A (2024) – “Standard for the Installation of Air-Conditioning and Ventilating Systems”; NFPA 90B (2024) – “Standard for the Installation of Warm Air Heating and Air-Conditioning Systems”

1.2. SUBMITTALS

1. Submit unit performance data including capacity, nominal and operating performance.
2. Submit Mechanical Specifications for unit and accessories describing construction, components, and options.
3. Submit drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
4. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

5. Drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

1.3. DELIVERY, STORAGE AND HANDLING

1. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
2. Protect units from physical damage. Leave factory shipping covers in place until installation.
3. Units to be secured via base rail tie-down locations.

1.4. WARRANTY

1. Provide parts warranty extending either 12-months from date of unit start-up or a maximum of 18-months from unit ship date.
2. Provide twenty-five-year heat exchanger limited warranty from unit ship date.
3. 5-year compressor warranty for units 25 tons and below.

1.5. REGULATORY REQUIREMENTS

1. Unit shall conform to the appropriate standards listed in Section 103 as well as be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for compliance with the following applicable standards.
2. Household and Similar Electrical Appliances – Safety - Part 2 - 40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners, and Dehumidifiers [UL 60335-2-40:2022 Ed.4] and [CSA C22.2#60335-2-40:2022 Ed.4]
3. ANSI Z83.4-2017/CSA 3.7-2017 – “Non-recirculating direct gas-fired heating and forced ventilation appliances for commercial and industrial application”; ANSI Z83.8-2016/ CSA 2.6-2016 – “Gas unit heaters, gas packaged heaters, gas utility heaters, and gas-fired duct furnaces”
4. In the event the unit is not approved by an NRTL for compliance with the appropriate standards, the manufacturer shall, at manufacturer’s expense, provide for a field certification and labeling of unit by an NRTL to the appropriate standards. Manufacturer shall, at manufacturer’s cost, complete any and all modifications required by NRTL prior to certification and field labeling. Manufacturer shall include coverage of all modifications in unit warranty.

2 PRODUCTS

2.1. SUMMARY

.1 The contractor shall furnish and install packaged outdoor air unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

.2 Approved Manufacturers

1. Trane: Horizon™ Model OA (Packaged Outdoor Air Unit) or approved equals.

2.2. GENERAL UNIT DESCRIPTION

.1 Unit(s) furnished and installed shall be packaged outdoor air unit(s) as scheduled on contract documents and described in these specifications. Unit(s) shall be designed for dehumidification, cooling and/or heating of 100% Outdoor Air. For dehumidification and cooling modes the evaporator temperature or supply air dewpoint shall be monitored, reported at unit controller. Compressor controls shall modulate capacity to maintain evaporator leaving set point for dehumidification mode. Hot Gas Bypass shall not be used to control compressor capacity. Compressor Hot Gas Reheat (HGRH) shall be factory installed. To prevent rehydration of evaporator condensate the reheat coil face shall be located a minimum of 6” downstream from the leaving face of the evaporator coil. Heating system shall include modulating controls. Compressor on-off only or primary heating on-off only controls shall not be acceptable control strategies.

.2 Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

.3 Unit discharge airflow configuration shall be:

1. Horizontal discharge thru unit roof curb.

2.3. CABINET

.1 Cabinet panels: 2” double-wall foamed panel with thermal break construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.

.2 Insulation: 2” polyurethane foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.

.3 Cabinet base shall be double wall construction designed to prevent trapping or ponding of water within the unit base. Cabinet floor shall be insulated with 2” double-wall foamed panel with thermal break construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed. Insulation shall not be applied to underside of unit base.

.4 Cabinet Base Rails: Side base rails shall include openings for forklift and/or tie-down and lift access. To protect unit base from fork damage side rails shall include removable heavy gauge fork pockets.

.5 Shipping anchors attach to and/or through unit base rails. Straps over unit shall not be used to secure unit for shipping.

.6 Cabinet material interior and base rails: shall be G-90 zinc-coated galvanized steel. Material gauge shall be a minimum of 14-gauge for base rails, 16-gauge for structural members and 22-gauge for access doors and cabinet panels.

.7 Exterior Corrosion Protection: Exterior cabinet panels shall be a base coat of G-90 galvanized steel with both exterior and interior surfaces cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit’s surface shall be in compliance with ASTM B117 salt spray testing at a minimum of 672-hour duration.

.8 Cabinet construction shall provide hinged panels providing easy access for all parts requiring routine service.

.9 Cabinet top cover shall be one-piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.

.10 Hinged Access Panels: Water- and air-tight hinged access panels shall provide access to all areas requiring routine service including air filters, heating section, electrical and control cabinet sections, optional ERV and power exhaust fan section, supply air fan section, evaporator and reheat coil sections. Insulated doors shall be constructed to allow the access door to open in either direction or be removed without removal of a hinge.

1. Latches with locking hasp or tool operated closure devices shall be factory installed on all hinged access panels.

.11 Drain Pan material shall be Type 304 Stainless steel drain and constructed to slope in two directions to ensure positive drainage with corners exposed to standing water and drain fittings welded liquid tight to prevent leaks. Pan shall have a minimum depth of 2” and be fully insulated by no less than 1” of R-6.6 insulation.

.12 Provide openings on either side of unit or thru the base for power, control, and gas connections.

.13 Cabinet shall include optional interior liner constructed of Type 304 stainless steel with sealed seams.

.14 Air inlet hood shall be factory installed and shall not require field assembly. Hood shall include 2” thick removable aluminum mesh mist eliminators sized for a velocity not to exceed 500 FPM at maximum unit rated airflow. Service access shall be hinged and held in place with thumb latches that shall not require tools for service access.

.15 Unit shall be equipped with a 6” filter rack upstream of the evaporator. Frame shall be field-adjustable to match any filter combination specified in the following section.

2.4. AIR FILTERS

.1 Unit inlet hood shall include 2” thick aluminum mesh removable mist eliminators with hinged access cover. Inlet velocity shall not exceed 500 FPM.

.2 Evaporator Inlet shall include a full complement of pleated media air filters. Filters shall be:

1. 2” deep MERV 13

2.5. DAMPERS

.1 Unit shall include a motor operated outdoor air damper constructed of galvanized steel.

.2 Damper blades shall be v-groove design with rubber edge seals designed not to exceed a 4 CFM/SQ FT leakage rate exceeding ASHRAE 90.1 damper leakage requirements. Airfoil design Class 1A rated dampers are optional.

.3 Damper actuator shall be factory mounted and wired sealed spring return and either two-position or fully modulating.

.4 Dampers air velocity shall not exceed 2000 fpm.

.5 Return Air damper shall be of same material, construction, and leakage rate as outdoor air damper. Return air damper actuator shall be factory mounted and wired sealed spring fully modulating and operate based on outdoor air damper feedback signal to properly regulate RA airflow.

2.6. DEHUMIDIFICATION / COOLING

.1 Compressors

1. All units shall have direct drive, scroll type compressors.
2. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
3. Internal overloads shall be provided with the scroll compressors.
4. Each compressor shall have a crankcase heater or equivalent to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
5. Each compressor shall be mounted on rubber vibration isolators, to reduce the transmission of noise.
6. Provide each unit with hermetically sealed refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, liquid line charging port, suction and liquid line pressure ports, sight glass, and thermal expansion valve.
7. Provide each circuit with automatic reset high and low pressure and high temperature switches for safety control.

.2 Coils

1. Evaporator, Condenser and Hot Gas Reheat coils shall be constructed with copper tubes mechanically bonded to configured aluminum plate fins.
2. Coils shall be factory leak tested in accordance ANSI/ASHRAE 15-1992 at a minimum pressure of 500 PSIG.
3. The condenser coil shall have a fin designed for ease of cleaning.
4. Evaporator coil shall include (six / four) rows of cooling interlaced for superior sensible and latent cooling with a maximum of 14 FPI for ease of cleaning.
5. Reheat coil shall be fully integrated into the supply airstream and be capable of delivering design supply air temperature.
6. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated by a minimum of six inches.
7. Condenser coil hail guards shall be factory installed.

.3 Condenser Section

1. Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets.
2. Fans shall be statically and dynamically balanced.

.4 Compressor Capacity Control

1. Mechanical Control: shall be equipped with Refrigerant Capacity Control (RCC) on the lead circuit to modulate compressor capacity during

Dehumidification or Cooling modes to prevent evaporator frosting or freezing. RCC shall be (standard mechanical). Hot gas bypass shall not be an acceptable compressor capacity control strategy. The RCC setpoint is factory set, and field adjustable, to maintain desired suction pressure and compressor discharge pressure.

2. Fans and Motors

.1 Indoor fan shall be direct drive plenum fan, factory installed and wired to on-board Variable Frequency Drive and shall be equipped with slide out service access.

.2 All fan motors shall be premium efficiency ODP and meet the U.S. Energy Policy Act of 2005/10 (EPACT).

.3 All fan motors shall either be permanently lubricated and/ or have internal thermal overload protection.

.4 Outdoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through in the vertical discharge position with either internal or external thermal protection. .

.5 Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.

2.7. HEATING

.1 Modulating Indirect Gas Fired Heating System

.1 Completely assembled and factory installed heating system shall be in the primary heating position located beneath the indoor fan assembly and be integral to unit and approved for use downstream from refrigerant cooling coils in units mounted outdoors. Threaded gas connection shall terminate at field provided manual shut-off valve. Provide capability for sidewall gas piping.

.2 Heaters shall include high turn-down burners firing into individual stainless-steel tubular heat exchangers. Heat exchangers shall be constructed of type 439 stainless steel and be a high efficiency dimpled tubular design capable of draining internal condensate. Units with multiple heaters shall include one fully modulating high turndown heater with additional on-off heater sections. Total heater turndown shall be based on heater gas input capacity 5:1 when ≤150 MBH or a minimum of 10:1 when >150 MBH.

.3 Heater outdoor air inlet shall be hooded and include internal baffle system to prevent rain blow thru. To prevent recirculation of flue gas and to prevent flue gas condensate from draining onto and obstructing the heater air inlet the inlet shall be hooded and shall be located a minimum of 8” beneath the flue outlet. Inlet hood shall include bird screen.

.4 Heater flue outlet(s) shall include hooded outlet with wire cloth all constructed of Type 430 stainless steel. Hooded outlet shall be sealed to prevent flue gas recirculation.

.5 Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, continuous air proving monitoring following ignition and continuous electronic flame supervision.

.6 Unit controls shall monitor heat output and shall discontinue all heating attempts and or unit operation in the event the heating section fails to ignite or fails to maintain programmed supply air temperature/time.

.7 Inducer fan shall be direct drive high pressure centrifugal type with two speeds and shall include built- in thermal overload protection.

.8 Limit controls: High temperature automatic reset limits shall be located on blower wall and in indoor fan chamber to shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow, or loss of indoor airflow.

.9 Flame roll-out safeties shall provide continuous monitoring of proper burner operation.

2.8. ELECTRICAL RATINGS AND CONNECTIONS

.1 All high voltage power components such as fuses, switches and contactors shall include a service personnel protection barrier or shall be a listed as touch-safe design.

.2 Field wiring access to be provided thru unit base into isolated enclosure with removable cover.

.3 Power wiring to be single point connection.

.4 Wiring internal to the unit shall be colored and labeled for identification.

.5 Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.

.6 Factory wired main power disconnect and overcurrent device shall be rated for total unit connected power

.7 Unit SCCR rating shall be a minimum of 5kA

.8 Factory wired Voltage/Phase monitor shall be included as standard. In the event of any of the following, the units will be shut down and a fault code will be stored in the monitor for the most recent 25 faults. Upon correction of the fault condition the unit will reset and restart automatically.

.1 Phase Unbalance Protection: Factory set 3%

.2 Over/Under/Brown Out Voltage Protection: +/-10% of nameplate voltage

.3 Phase Loss/Reversal

.9 Factory to mount and wire optional 115-volt convenience outlet. Field wiring of convenience outlet not acceptable.

.10 All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.

2.9. UNIT CONTROLS

.1 Unit to be supplied with a terminal block for a 3rd party controls integration. Any ancillary sensors and sequencing is the responsibility of the controls provider.

.2 Refrigerant Detection System (RDS)

.1 Systems with refrigerant classified as A2L shall include RDS.

.2 RDS shall engage mitigation measures at 12% of LFL.

.3 Mitigation will continue for 5 minutes once the alarm is cleared.

.4 Detection of refrigerant leak(s) in the airstream shall:

.1 De-energize compressors, UV Lights, heaters, and fan motors, excluding Indoor Fan Motor(s).

.2 Run indoor fan motor(s) at minimum Hz.

.3 For building comfort, to avoid freezing or overheating the space, the damper command will not change, and the unit will still provide full dilution of any leaked refrigerant.

.1 Except for units with 2 position dampers and no return duct. In which case the damper shall be commanded open.

.4 24VAC status terminal will energize on OAUTS.

.5 Detection of refrigerant leak(s) in a non-airstream compartment shall:

.1 De-energize all loads including: compressors, motors and heaters.

.2 Energize the mechanical ventilation fans internal to the unit.

.6 E-stop shall be given priority control of the unit over that of the RDS.

2.10. B.10 POWER EXHAUST – BAROMETRIC RELIEF

.1 Provide a factory installed power exhaust assembly that shall be designed to ventilate return air to atmosphere.

.2 Plenum mounted direct drive airfoil design exhaust wheel material shall be heavy gauge aluminum, welded construction and rated for up to Class III speed/pressure performance. Factory install and wire fan motor to on-board Variable Frequency Drive. Belt-drive and/or forward curve plenums fans shall not be used.

.3 Exhaust to discharge through gravity dampers located on each side of unit cabinet.

.1 barometric relief dampers with counterbalance weight in place of gravity dampers

2.11. OUTDOOR AIR SECTION ENERGY RECOVERY (ERV)

.1 Composite energy recovery wheel

.1 General Specifications.

.1 The energy recovery cassette shall incorporate a rotary wheel in an insulated cassette frame complete with removable energy transfer media, seals, drive motor and drive belt.

.2 Energy recovery wheel performance shall be AHRI 1060 certified and bear the AHRI certified label. Components that are independently tested or “rated in accordance with” shall not be acceptable. Manufacturer membership in AHRI is not an acceptable substitute. Certified components must be listed as active in the AHRI Directory. (www.ahridirectory.org)

.3 The energy recovery cassette shall be an Underwriters Laboratory UR recognized component for fire and electrical safety and bear the UR symbol. Recognized components shall be listed in the UL directory. (http://database.ul.com)

.4 The energy recovery cassette shall comply with NFPA 90A by virtue of UL standard 1812 and UL900 fire test for determination of flammability and smoke density.

.5 The energy recovery cassette shall carry a 5-Year standard warranty on the entire cassette assembly (excluding the motor) from the date of shipment. Motors shall carry the manufacturers standard 18 month warranty from the date of manufacture.

.2 Cassette Frame and Wheel Construction.

.1 Cassette frame and structural components shall be constructed of G90 galvanized steel for corrosion resistance.

.2 Wheel structure shall consist of a welded hub, spoke and continuous rolled rim assembly of stainless steel, and shall be self-supporting without energy transfer segments present.

.3 Wheel structure shall be connected to the shaft by means of taper lock bushings.

.4 Wheel bearings shall be permanently sealed and selected for a minimum 30 year L-10 life of 400,000 hours. Bearings requiring external grease fittings or periodic maintenance are not acceptable.

.5 Standard cassette may be affixed within the cabinet in any orientation without the need for factory modification.

.3 Energy Transfer Media

.1 Energy transfer media shall be constructed of a durable synthetic lightweight polymer.

.2 Media shall be wound continuously with one flat and one structural layer in an ideal parallel plate geometry. Airflow across heat exchanger surface shall remain laminar.

.3 Energy transfer media shall not exceed 3” in depth.

.4 Energy transfer media shall be suitable for use in corrosive, marine or coastal environments without the need for additional coatings.

.5 Sensible only energy transfer media shall be constructed in the same fashion as the enthalpy transfer media with the exception of the desiccant coating process required for enthalpy wheels.

.4 Coatings and Desiccant.

.1 Desiccant shall be either silica gel or molecular sieve and permanently bonded to the energy transfer media without the use of binders or adhesives, which may degrade desiccant performance. Desiccants not permanently bonded are not acceptable due to potential delamination or erosion of the desiccant from the energy transfer media.

.2 Desiccant shall be non-migrating nor shall it dissolve or deliquesce in the presence of water or high humidity.

.3 Energy transfer media shall be capable of repeated washings without significant degradation of the desiccant bond as documented.

.5 Removable Energy Transfer Segments.

.1 Wheels 25" in diameter and greater shall be provided with removable energy transfer segments.

.2 Segments shall be removable without the use of tools to facilitate maintenance and cleaning.

.6 Seals

.1 All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set.

.2 Seals shall be non contact nylon pile brush seal orientated in a labyrinth style configuration.

.3 Diameter Seals shall be fully adjustable and easily accessible.

.4 Perimeter seals shall be permanently mounted to the wheel rim and not require adjustment. Seals that mount to the frame are not acceptable.

.7 Drive System

.1 The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box.

.2 Three phase motors shall be suitable for use in both standard and inverter rated applications.

.3 Wheels 52” and smaller shall use a urethane stretch belt for wheel rim drive without the need for external tensioners.

.4 Wheels 58” and larger shall use a urethane non-stretch belt with integral cord and constant tensioner.

.5 Wheel drive system shall not require periodic adjustment.

.8 Maintenance

.1 Energy recovery segments shall be cleanable outside of the cabinet with detergent or alkaline coil cleaner and water.

.2 Energy transfer segments shall be capable of submersion in a cleaning solution. Submersion shall be capable of restoring latent performance to within AHRI certified performance limits.

.9 Purge

.1 A mechanical purge shall be available as an optional accessory as to avoid excessive fan power.

.2 When required the mechanical purge sector shall be factory installed and field adjustable.

.3 Purge settings shall be calculated using AHRI certified data and adjusted per the wheel manufacturers selection software.

.4 Purge shall be capable of limiting Exhaust Air Transfer Ratio (EATR) values to 0.4% through proper fan and purge adjustment.

2.12. B.12 ROOF CURB

.1 Contractor shall provide factory supplied roof curb, 18 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.

.2 Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

2.13. B.13 EXECUTION

.1 Examination

.1 Contractor shall verify that roof is ready to receive work.

.2 Contractor shall verify that proper power supply adequate to supply the unit.

2.14. INSTALLATION

.1 Contractor shall install in accordance with manufacturer's instructions.

.2 Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

2.15. MANUFACTURER’S FIELD SERVICES

.1 Unit start-up and commissioning shall be completed by a Factory-trained and factory-certified technician.

.2 Manufacturer must have twenty factory-authorized and factory-trained technicians within a 50-mile radius of job site.

.3 The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 This document serves as the design guide for the Building Automation Systems (BAS) to be installed at specified Hamilton-Wentworth District School Board (HWDSB) locations, including the complete remote integration to the existing HWDSB Building Management System Server –BMS, for remote administration and central control. The BAS system's full deployment and implementation shall be the responsibility of the BAS/BMS integrator. This section also defines the responsibilities of the Mechanical (Division 23) and Electrical (Division 26) trade contractors pertaining to control products or sub-systems, furnished by each trade, that will be integrated to the BAS.

.2 All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification guideline, shall be provided without additional cost to HWDSB.

1.2. SYSTEM DESCRIPTION

.1 The BMS shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

.2 Any and all components of the BMS that are connected via field bus or IP network, including the network controllers, field controllers, application specific controllers, server and user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system, and shall be manufactured by the same BMS manufacturer. Systems that use or require network controllers, field controllers, application specific controllers, server and user interface software, programming tools and software from more than one BMS manufacturer shall not be accepted.

.3 All points of user interface shall be on standard computing devices that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these devices will be a standard Web Browser.

.4 Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server.

.5 The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

.6 The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

.7 Provide a complete, neat, and workmanlike installation. Use only manufacturer employees or subcontractors who are skilled, experienced, trained, and familiar with the specific equipment, software, standards, and configurations to be provided for this Project.

.8 Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as not to impede or delay the work of associated trades.

.9 The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

.1 Operator information, alarm management and control functions

.2 Information management including monitoring, transmission, archiving, retrieval, and reporting functions

.3 Diagnostic monitoring and reporting of BMS functions

.4 Energy management

.5 Standard applications for terminal HVAC systems

.6 Enterprise-wide information and control access

.7 Offsite monitoring and management access

.8 Fault Detection and Fault Triage

1.3. INSTALLATION

.1 Have factory-trained and experienced personnel to perform the work described in all sections of Division 25.

.2 Ensure qualified supervisory personnel continuously direct and monitor work and attend site meetings.

.3 All wiring for electrical work must be completed in accordance with Electrical Division, manufacturer's recommendations and the Ontario Electrical Safety Authority (ESA).

1.4. UPGRADE AND ADDITION PROCESS (SWITCHOVER PROCESS)

.1 All existing control systems must remain functional during normal operation hours until the new BAS is fully functional and verified before final switch over.

.2 Minimize downtime of electro-mechanical equipment to ensure building ambient conditions are put back to normal conditions immediately after switchover.

.3 All new panel installation and activities causing the building systems downtime must be coordinated with the Project Manager. Obtain permission form Project Manager before proceeding with work causing any interruption to the normal operation of the building.

1.5. EXISTING CONDITIONS – CONTROL COMPONENTS

.1 Following new EMCS installation, remove all the existing controls no longer required in the new EMCS arrangement. This work includes all existing control devices, cabinets, conduits, cables, network wiring and pneumatic tubing. Place in approved storage for disposition as directed

1.6. ELECTRICAL INSTALLATION

.1 Division 25 is responsible for the hiring of a qualified and licensed Electrical contractor for the following work:

.1 Complete electrical installation including all conduits, cables, junction box, etc. required for control and automation systems.

.2 120V single phase power source for DDC controls, local monitoring panels, cabinets and transformers provided by this Division.

.3 All connections to motor control centers or starters, interlocks for fans, pumps and other control components.

.4 Grounding systems required for all systems and devices provided under Division 25, in accordance with manufacturer's instructions and requirements of Electrical Division.

.5 Inspection of existing power sources (120V/1/60) intended to be re-used for the new EMCS complete with report, as described in item “EXISTING CONDITIONS - CONTROL COMPONENTS”

.2 Quality Assurance:

.1 The electrical contractor providing the electrical installation for Division 25 to be fully competent in the type of work described in these specifications and to be familiar with the electrical and grounding requirements of this type of installation

.2 Provide qualified personnel that have been trained for the installation of electrical systems specific to DDC controls, instrumentation and networking infrastructure.

.3 Electrical contractor to hold a valid Master Electrical contractor license as issued by the Province that the work is being constructed.

.3 Execution

.1 Complete installation in accordance with Electrical Division and the Ontario Electrical Safety Code.

.2 Modify starters to provide for EMCS as indicated on drawings. Refer to electrical control schematics included as part of control design schematics on drawings. Provide wiring schematics including additions, deletions to control circuits.

.3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.4 Provide grounding for controls systems and the EMCS installation in accordance with Electrical Division.

.4 Wiring:

.1 Wiring must be continuous without joints.

.2 All wiring shall be run in EMT conduit unless specified otherwise

.3 Maximum conduit fill not to exceed 50%

.4 Use of FT6 plenum-rated cables without conduits is only authorized in accessible ceiling space, for connection of EMCS components (24V power supply, room sensor, control valve, etc.) to an application-specific digital controller (TCU) or local control unit (LCU).

.5 When FT6 plenum cables are run without conduits, wiring must follow the building lines and must be attached properly every 1.5 meters using hooks (or Velcro) specifically designed for this purpose.

.6 Hooks (or Velcro) must be fixed properly to the building structure and must not be attached to existing building systems such as electrical conduits, ductwork, piping, etc. or their associated hangers. The useof tape or tie-wraps is prohibited.

.7 Provide protection against the abrasion of cables when running FT6 plenum-rated cables to sensors or other accessories inside the wall.

.8 Communication trunks and power wiring must be run in corridors, away from closed offices.

.9 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Consultant to review before starting Work.

.10 Wiring in mechanical rooms, wiring in service rooms and in general any exposed wiring anywhere in the building must be in conduit.

.11 Wiring sizes

.1 120 V: #12AWG minimum.

.2 24 V: #18AWG minimum.

.12 Power loss through conductor shall not exceed 5%.

.5 Ethernet Network:

.1 All Ethernet cables, for connection of IP-enabled devices to the EMCS, shall be supplied by Division 25.

.2 Division 25 is responsible for providing the EMT conduit infrastructure that will be used to run Ethernet cables to EMCS and integrated devices.

.3 In all cases, coordinate with the Telecommunications Specialist to ensure the conduit infrastructure deployed complies with EIA/TIA standards

1.7. SUBMITTAL

.1 Provide 4 sets of As-built drawings of the entire BAS system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. Division 23 and 16 contractors supplying HVAC products and sub-systems as part of their packages, shall provide catalog data sheets, wiring diagrams and point lists to the BAS/BMS Integrator for proper coordination and implementation of work.

.2 Submittal shall also include a trunk cable schematic diagram depicting User, control panel locations and a description of the communication type, media and protocol. Though the Division 23 and 16 contractors shall provide these diagrams for their portions of work, the BAS Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire BAS Local Area Network (LAN) and HWDSB's internal Wide Area Network (WAN).

.3 Submittal shall also include a complete point list of all input/output points to be executed by the BAS/BMS Integrator. Division 23 and 26 contractors shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the BAS.

.4 Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be about 90% complete at this stage with the only remaining changes, to be based on review comments from the design team and HWDSB. The BAS system graphics shall be developed and programmed by the BAS/BMS Integrator and linked and loaded to the HWDSB Main BMS Server.

.5 Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Six copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. Division 23 and 26 contractors shall provide as-builts for their portions of work. The BAS/BMS Integrator shall be responsible for as-built drawings pertaining to overall BAS/BMS network architecture and control diagrams.

1.8. SPECIFICATION NOMENCLATURE

.1 Acronyms used in this specification are as follows:

.2 BAS Building Automation System (BAS)

.3 BMS Building Management System (BAS)

.4 DDC Direct Digital Controls

.5 GUI Graphical User Interface

.6 HOA Hand-Off-Auto

.7 IDC Interoperable Digital Controller

.8 IBC Interoperable BACnet Controller

.9 JACE Java Application Control Engine

.10 LAN Local Area Network

.11 NAC Network Area Controller

.12 OOT Object Oriented Technology

.13 PICS Product Interoperability Compliance Statement

.14 VFD Variable Frequency Drive

.15 WBI Web Browser Interface

.16 WAN Wide Area Network

1.9. DIVISION OF WORK

.1 The BAS/BMS Integrator shall be responsible for the software and programming of the NACS, local DDCs, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, trend logs and alarms, BacNet network management, and connection of the NAC to the local network and the HWDSB wide area network BMS System Server. The BMS Integrator shall also be responsible for all controllers (IDC and IBC), controller programming, software setup, and BAS field device installation and installation.

.2 The Division 23 and 26 contractors (if applicable), shall install control field instrumentation devices, control panels, controller input/output, and power wiring and controller network wiring.

1.10. RELATED WORK UNDER THIS CONTRACT

.1 Division 23, Mechanical:

.1 Providing control devices and systems including but not limited to:

.1 Control field instrumentation devices.

.2 Local equipment controller/sequencer and field instrumentation devices.

.2 Division 26, Electrical:

.1 Providing motor starters, disconnect, and HOA switches (unless otherwise noted).

.2 Line power wiring and conduit (unless otherwise noted).

.3 Provision, installation and wiring of duct smoke detectors (unless otherwise noted).

.4 Control panels Installation controls equipment and wiring as required.

.5 Rough-in and wiring of control field instrumentation.

1.11. AGENCY AND CODE APPROVALS

.1 All products shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

.1 UL-916; Energy Management Systems

.2 C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “signal Equipment”

.3 CE

.4 FCC, Part 15, Subpart J, Class A Computing Devices

1.12. SOFTWARE LICENSE AGREEMENT

.1 As required, the BMS Contractor shall provide software licenses in the name of the owner for programming, configuration and graphics building tools to allow designated representatives to make changes, modifications or additions to the system. While future updates or revisions may require an update fee, the owner shall incur no additional cost if they choose not to update. Systems that require any annual or time-limited licensing fees shall not be permitted.

1.13. DELIVERY, STORAGE AND HANDLING

.1 Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.14. JOB CONDITIONS

.1 Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be the BAS/BMS Integrator’s responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

2 PRODUCTS

2.1. AUTOMATIC CONTROL VALVES AND OPERATORS

.1 General:

.1 Body and trim materials selected in accordance with specification for globe valves, ball valves, or high-performance butterfly valves, and in accordance with manufacturer's recommendations for design conditions and service.

.2 Size control valves for pressure drops and heating and cooling loads as scheduled with same pressure rating as globe valves under same service and pressure conditions.

.3 Size valves for two port and three port, two position service;

.1 line size,

.2 ball valves, sizes NPS 1 ½ and smaller,

.3 butterfly valves, sizes NPS 2 and larger.

.4 For two port and three port modulating service;

.1 use globe valves for CV rating 160 and smaller,

.2 use butterfly valves for CV rating above 160.

.5 Select butterfly valves based on CV rating at 70° rotation

.2 Water and glycol valves:

.1 Two position service;

.1 Straight through two port type, single seated, with replaceable disc or ball,

.2 Quick opening linear or equal percentage flow characteristics.

.2 Modulating service;

.1 Straight through two port type, single seated,

.2 Equal percentage flow characteristics.

.3 Modulating diverting service; three port mixing valves,

.1 Linear for each port to give constant total flow or,

.2 Equal percentage flow characteristics with 25% valve authority (valve pressure drop equal to 33% pressure drop through load at full flow).

.4 Actuator and trim selected for close-off pressure ratings as follows;

.1 Two-way modulating or two position service; 150% of pump shut off head.

.2 Three-way modulating service; 300% of pressure differential between ports A and B at design flow or 100% of pump shut off head.

.3 Shut off head to be based on maximum rpm when pump is fitted with VFD

.5 Sized as follows;

.1 For two-position service; line size.

.2 For two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;

.1 200% of pressure drop through heat exchanger,

.2 100% of pressure drop through coil,

.3 50% of pressure difference between supply and return mains, or

.4 35 kPa (5 psi).

.3 For three-way modulating service; pressure drop equal to smaller of;

.1 Twice pressure drop through coil or heat exchanger, or 35 kPa (5 psi).

.4 For valves for radiation, terminal units and reheat coils;

.1 pressure drop of 7kPa (1 psig)

.5 Failed position on isolation from control signal as follows;

.1 Heating water and glycol zone valves; normally open.

.2 Heating coil valves in AHU; normally open.

.3 Hot water and glycol differential pressure by-pass control valves; normally closed.

.6 Manufactured Belimo or acceptable alternate.

2.2. ELECTRIC/ELECTRONIC ACTUATORS – VALVES

.1 Valve actuators for service:

.1 Sized and selected in accordance with manufacturer's specifications,

.2 Electric/electronic for two position, or proportional control action, coupled to valves with linkage,

.3 Electronic interface control board, solid state drive, reversible motor, oil immersed gear train,

.4 Electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,

.5 Span and zero travel adjustment,

.6 Position feedback signal on actuators used for proportional control,

.7 Provision for manual positioning of valve when actuator is not powered,

.8 Spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),

.9 Control signals:

.1 0 to 10VDC or 0 to 20ma,

.2 Modulate damper position with 2 to 10VDC or 4 to 20ma input signal operating range when in proportional service.

.3 Input type and range as suitable for interfacing to output of BAS controller

.10 Feedback signals:

.1 Two independent adjustable travel limit switches and wiring to BAS for indication of valve position.

.11 General purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

.12 Electric actuators suitable for operation down to -35°C where installed outdoors.

.13 Manufactured Belimo or acceptable alternate.

2.3. SPACE THERMOSTAT CONTROLLER FOR HEAT PUMPS

.1 Basis of design: Johnson control, TEC3631-14-000 two-stage heat pump thermostat controller (wired)

.2 Power requirement: 19 to 30 VAC, 50/60 Hz, 4 VA at 24 VAC nominal, Class 2 or safety extra- low voltage (SELV)

.3 USB port power rating: 120 to 250 mA current draw supported

.4 Analog output rating : 0 to 10 VDC into 2k ohm resistance (minimum)

.5 Relay contact rating: On/off or floating control, 19 to 30 VAC, 1.0 A maximum, 15 mA minimum, 3.0 A in-rush, Class 2 or SELV

.6 Fan relay output rating: 19 to 30 VAC, 1.0 A maximum, 15 mA minimum, 3.0 A in-rush

.7 Auxiliary output rating/triac output: 19 to 30 VAC, 1.0 A maximum, 15 mA minimum, 3.0 A in-rush

.8 Binary inputs: Dry contact across terminal COM to terminals BI1or BI2

.9 Analog inputs (three AIs): Nickel, platinum, A99B, 2.25k ohm NTC,10k ohm NTC, 10k ohm NTC Type 3 across terminal COM to terminals R, SEN, SAT, or OAT, 0-10 VDC

.10 Temperature and humidity sensor type: Local digital sensor

.11 Wire size: 18 AWG (1.0 mm diameter) maximum, 22 AWG (0.6 mm diameter) recommended

.12 MS/TP network guidelines: Up to 100 devices maximum for each Network

.13 Automation Engine (NAE); 4,000 ft (1,219 m) maximum cable length.

.14 Temperature range:

.1 Backlit display -40.0°F/-40.0°C to 122.0°F/50.0°C in 0.5° increments

.2 Heating control 40.0°F/4.5°C to 90.0°F/32.0°C

.3 Cooling control 54.0°F/12.0°C to 100.0°F/38.0°C

.15 Accuracy

.1 Temperature ±0.9F°/±0.5C° at 70.0°F/21.0°C typical calibrated

.2 Humidity ±5% RH from 20 to 80% RH at 50 to 90°F (10 to 32°C)

.16 Minimum deadband 2F°/1C° between heating and cooling

.17 Occupancy sensor motion detection: Minimum of 94 angular degrees up to a distance of 15 ft (4.6 m); based on a clear line of sight

.18 Ambient conditions

.1 Operating 32 to 122°F (0 to 50°C); 95% RH maximum, noncondensing

.2 Storage -22 to 122°F (-30 to 50°C); 95% RH maximum, noncondensing

.19 Compliance:

.1 BACnet International, BACnet Testing Laboratories™ (BTL) 135-2001 Listed BACnet Advanced Application Controller (B-AAC)

.2 United States UL Listed, File E27734, CCN XAPX, Under UL60730 Networked models: FCC Compliant to CFR 47, Part 15, Subpart B, Class B

.3 Canada: UL Listed, File E27734, CCN XAPX7, Under E60730, Networked models: Industry Canada, ICES-003

.20 Shipping weight:

.1 Models without occupancy sensor 0.75 lb (0.34 kg)

.2 Models with occupancy sensor 0.77 lb (0.35 kg)

2.4. CONTROL DAMPERS AND OPERATORS

.1 "TAMCO" 100 mm (4') deep, flanged, AMCA low leakage certified aluminium dampers or approved equal and accepted by the Engineer/Owner. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4'). Dampers greater than two sections wide are to be complete with a jackshaft. Each damper is to be complete with:

.1 an extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;

.2 extruded TPE frame gaskets and extruded EPDM blade gaskets;

.3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in the frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.

.2 **Standard Damper:** Series 1000 as above.

.3 **Insulated Damper:** Series 9000 as above but with all four sides of the frame insulated with polystyrene, and the blades thermally broken and insulated with expanded polyurethane foam.

.4 **General Re: Damper Operators**: Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control the damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit the sizes of dampers involved, and to provide sufficient force to maintain the damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit the length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to the damper shaft. Operators for dampers to be connected to the building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit the dampers to respond and go to the required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for the environment in which they are located.

.5 **Electric Damper Operators**: Equal to Belimo EF Series 24 volt or 120-volt AC spring return, direct coupled electric motor operators for either modulating or two position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.

2.5. LOCAL CONTROL PANELS

.1 NEMA/EEMAC 1 wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.6. CONTROL SYSTEM COMPONENTS

.1 Components specified below are required for control of equipment and systems as per the drawing control diagrams and sequences of operation. Not all required components may be specified.

.2 **Sensor/Transmitter Input Devices:** Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are to be as follows:

.3 **General re: temperature sensors**: resistance type, either two-wire 1000-ohm nickel RTD or two-wire 1000 ohm platinum RTD with accuracy (includes errors associated with the sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:

.1 Room temperature, and duct temperature points, ±1°C (±0.5°F);

.1 All other points, ± 0.75°C (±1.3°F).

.4 **Outside air sensors**: designed and constructed for ambient temperatures and to withstand the environmental conditions to which they are exposed, complete with a NEMA/EEMAC 3R enclosure, solar shield, and a perforated plate surrounding the sensor element where exposed to wind velocity pressure.

.5 **Duct mounting sensors**: insertion type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in the duct;

.6 **Duct/plenum averaging sensors**: for ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of the duct/plenum;

.7 **Carbon dioxide sensors:** carbon dioxide sensors for air quality control purposes are to have a maximum twenty second response time, are to be suitable for operating conditions of from 0 to 50°C (32 to 122°F) and 0 to 100% RH non-condensing, are to be complete with a calibration kit (to be handed to Owner) and are to have characteristics as follows:

.1 Measurement range: 0 to 2000 ppm;

.2 Accuracy: ±100 ppm;

.3 Repeatability: ±20 ppm;

.4 Drift: ±100 ppm per year;

.5 Output signal: 0 to 10 VDC proportional over the 0 t0 2000 ppm range.

.8 **Differential Pressure Transmitters**: Pressure transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input. Pressure transmitters are to transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal. Differential pressure transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for balancing, etc. Transmitter housing are to suit the mounting location. Standalone pressure transmitters are to be mounted in a minimum NEMA/EEMAC 1 (NEMA/EEMAC 2 in sprinklered area) by-pass valve assembly panel with high and low connections piped and valved, air bleed units, by-pass valves, and compression fittings. Transmitters are to be as follows:

.9 **Low differential water pressure, 0 to 5 kPa (0 to 20" wc):** equal to Setra or Mamac industrial quality transmitter capable of transmitting a linear 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments that are adjustable from outside the cover, and performance as follows:

.1 Maintain accuracy up to 20 to 1 ratio turndown;

.2 Reference accuracy - +0.2% of full scale.

.10 **Medium to high differential water pressure, over 5 kPa (20" wc):** equal to Setra or Mamac transmitters as specified above for low pressure transmitters but with a pressure range of from 2.5 kPa (10" wc) to 2070kPa (300 psi), a reference accuracy of ±1% of full span (includes non-linearity, hysteresis, and repeatability)

.11 **Building differential air pressure:** industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments that are adjustable from outside the cover, and performance as follows:

.1 Maintain accuracy up to 20 to 1 ratio turndown;

.2 Reference accuracy - +0.2% of full span.

.12 **Low differential air pressure, 0 to 1.25 kPa (0" to 5" wc):** industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments that are adjustable from outside the cover, and performance as follows:

.1 Maintain accuracy up to 20 to 1 ratio turndown;

.2 Reference accuracy - +0.2% of full span.

.13 **Medium differential air pressure, over 1.5 kPa (5" wc):** transmitters as specified above for low pressure air transmitters but performance requirements as follows:

.1 Zero & span: (c/o F.S./Deg. F);.04% including linearity, hysteresis, and repeatability;

.2 Accuracy: 1% F.S. (best straight line); static pressure effect: 0.5% F. S.;

.3 Thermal effects: <+0.33 F.S./Deg. F over 40°F to 100°F (calibrated at 70°F.

.14 **Smoke Detectors**: Ionization type duct mounting detectors supplied as part of the electrical work for mounting as part of the control system work.

.15 **Status and Safety Switches**: Double contact switches to monitor equipment status and safety conditions and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:

.1 **Current sensing switches**: equal to Veris Industries self-powered dry contact output switches for sensing the run status of motor loads, each calibrated to indicate a positive run status only when the motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;

.2 **Air filter status switches**: automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;

.3 **Air flow switches**: pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;

.4 **Air pressure safety switches**: manual reset switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC and an appropriate scale range and pressure adjustment;

.5 **Water flow switches**: Equal to Honeywell WFS-1001-H;;

.6 **Low temperature limit switches**: manual reset type each complete with DPST snap acting contacts rated for 16 amperes at 120 VAC, a minimum 4.5 m (15') sensing element for mounting horizontally across the duct/plenum with sensing reaction from the coldest 450 mm (18") section of element, and where the sensing element does not provide full coverage of the air stream, additional switches are to be supplied as required.

.16 **Control Relays**: Control relays are to be as follows:

.1 **Control pilot relays**: modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3PDT or 4PDT as required for the application, with contacts rated for 10 amperes at 120 VAC;

.2 **Lighting control relays**: latching type with integral status contacts rated for 20 amperes at 120 VAC, each complete with a split low voltage coil that moves the voltage contact armature to the On or Off latched position, each controlled by a pulsed tri-state output (preferred) or pulsed paired binary outputs, and each designed so that power outages will not result in a change-of-state and so that multiple same state commands will simply maintain the commanded state.

.17 **Electronic Signal Isolation Transducers**: Equal to Advanced Control Technologies signal isolation transducers for installation whenever an anolog output signal from the building automation system is to be connected to an external control system as an input (i.e. equipment control panel), or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.

.18 **External Manual Override Stations**: Each manual override station is to be complete with contacts rated minimum 1 ampere at 24 VAC and is to provide the following:

.1 An integral HAND/OFF/AUTO switch to override the controlled device pilot relay;

.2 A status input to the building automation system to indicate whenever the switch is not in the AUTO position;

.3 A status LED to illuminate whenever the output is On;

.4 An override LED to illuminate whenever the HOA switch is in either the HAND or OFF position.

3 MATERIALS

3.1. GENERAL

.1 The Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers, web-server controller, graphical user interface software, network devices and other devices as specified herein.

.2 The installed BAS system shall provide secure password access to all features, functions and contained data for remote interfacing to the HWDSB Centralized Building Management System.

3.2. OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

.1 The intent of this specification is to provide a peer-to-peer network, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet in one interoperable system. Otherwise open communication protocols may be allowed, upon prior approval by the HWDSB Building Energy Systems –Sr. Manager.

.2 Adherence to industry standards not limited to ANSI / ASHRAE™ Standard 135-2001, BACnet assure interoperability between all system components, is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance shall support the ability to support data read and write functionality and those features as specified. Physical connection

.3 of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

.4 All components and controllers supplied shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

.5 The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the HWDSBC main BMS server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

.6 A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening HWDSB's internal network. Systems employing a "flat" single tiered architecture shall not be acceptable.

.1 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

.2 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

3.3. NETWORKS

.1 The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, HTML, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

.2 Local area network minimum physical and media access requirements:

.1 Ethernet; IEEE standard 802.3

.2 Cable; 100 Base-T, UTP-8 wire, category 6

.3 Minimum throughput; 100 Mbps.

.3 Remote Access.

.1 Provide access to the LAN from a remote location, via the Internet. HWDSB shall provide a connection to the Internet to enable this access via high speed modem, ISDN line, T1 Line or via the HWDSB's Intranet to a corporate server. HWDSB agrees to pay monthly access charges for connection to ISP service.

3.4. NETWORK AREA CONTROLLER (NAC)

.1 General

.1 The Network Area Controller (NAC) shall be a fully user-programmable, supervisory controller. The NAC(s) shall monitor the network of distributed equipment controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other NAC(s).

.2 Automation network – The NAC(s) shall reside on the automation network and shall support a subnet of system controllers.

.3 User Interface – Each NAC shall have the ability to deliver a web-based User Interface using the Site Management Portal functionality previously described. All computers connected physically or virtually to the automation network shall have access to the web-based user interface.

.1 The web-based user interface software shall be embedded in the NAC(s). Systems that require a local copy of the system database on the user's device are not acceptable.

.2 The NAC(s) shall support a minimum of two (2) concurrent users.

.3 The web-based user interface shall have the capability to access all system data through a single NAC.

.4 Remote users connected to the network using a Virtual Private Network (VPN) shall also have total system access through one NAC.

.5 Systems that require the user to address more than one NAC to access all system information are not acceptable.

.6 The NAC shall have the capability of serving web-based user interface graphics. The graphics capability shall be embedded in the NAC.

.7 Systems that only support user interface graphics from a central database or require the graphics to reside on the user's device are not acceptable.

.8 The web-based user interface shall support the following functions using a supported web browser:

.1 Configuration

.2 Commissioning

.3 Data Archiving

.4 Monitoring

.5 Commanding

.6 System Diagnostics

.9 Systems that require workstation software or modified web browsers for system queries are not acceptable.

.4 Processor – The NAC(s) shall be microprocessor-based with a minimum word size of 32 bits. The NAC(s) shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAC(s) size and capability shall be sufficient to fully meet the requirements of this Specification.

.5 Memory – Each NAC shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

.6 Secure Boot – The NAC(s) shall prevent malicious or unauthorized software applications from loading during the system startup process.

.7 User Authentication – The NAC(s) shall support local user authentication.

.8 Password Security – Access to the NACs' embedded user interface shall require a password of 8 to 50 characters including a minimum of one lower case letter, one upper case letter, one number, and one special character. An alarm shall be generated after three unsuccessful attempts within 15 minutes, and the user shall be denied access until permission is renewed by a system administrator.

.9 Network Security – Communication between the NAC and other system networked devices including additional NACs, Application and Data Servers, Open Data Servers (BACnet listed OWS), and user interface clients shall be encrypted and support HTTPS with Transport Level Security (TLS) Version 1.2. Self-signed certificates are to be provided with the option of configuring trusted certificates.

.10 Hardware Real Time Clock – The NAC(s) shall include an integrated, hardware-based, real-time clock, with a supercapacitor to maintain time for a minimum of 72 hours during a power loss. Controllers using a battery to maintain time during a power loss shall not be acceptable.

.11 Diagnostics – The NAC(s) shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The NAC(s) shall provide both local and remote annunciation of any detected component failures or repeated failures to establish communication.

.12 Power Failure – In the event of the loss of normal power, the NAC(s) shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

.1 During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

.2 Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

.13 Certification – The NAC(s) shall meet and be listed to the UL 916 Standard for Energy Management Equipment and be FCC Compliant to CFR47, Part 15, Subpart B, Class A.

.14 Device Integration – The NAC(s) shall support integrating networked devices using the following communication protocols on the device/controller network:

.1 The NAC(s) shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135 on the controller network.

.1 The NAC(s) shall support Remote Field Bus integration via a BACnet IP to MS/TP router.

.2 The NAC(s) shall be tested and BTL listed/certified as a BACnet Building Controller (B-BC).

.3 A BACnet Protocol Implementation Conformance Statement shall be provided for the NAC(s).

.4 The Protocol Implementation Conformance Statement shall be provided.

.2 The NAC shall support LonWorks enabled devices using a whitelisted USB-to-LonWorks FTT10 Free Topology Transceiver adapter.

.3 All LonWorks controls devices shall be LonMark® certified.

.4 The NAC(s) shall optionally support integration of networked devices using the following networking protocols:

.1 MODBUS RTU

.2 MODBUS TCP

.3 KNX - KNX is an open communication standard (EN 50090, ISO/IEC 14543) that many European manufacturers have applied to lighting controls, blinds and shutters, HVAC controls, security systems, energy management, audio, video, displays, and remote controls.

.4 M-Bus - M-Bus (Meter Bus) is a European standard (EN 1434-3) that applies primarily to energy and heat meters.

.5 C-CURE 9000 Access Control System

.6 victor Video Management System

.7 OPC UA

.15 The NAC(s) shall include the following multi-color, flashing LEDs to indicate important operating conditions and status:

.1 Heartbeat – to indicate each of the following states: operational (normal), powered but not operational, starting up, shutting down, or no power applied

.2 Fault – to indicate if fault conditions have been detected

.3 Ethernet Activity – to indicate if Ethernet Traffic is occurring or not occurring.

.4 Ethernet Link Speed – to indicate the speed of Ethernet Link (10, 100, or 1000 Mbps)

.5 Site Director – to indicate if the NAC has been designated as the Site Director

.6 BACnet/IP – to indicate if the NAC is transmitting BACnet messages over BACnet/IP to other devices, including other NACs

.7 USB -1 – to indicate if a supported device is connected, no device is connected, or an unsupported device is connected on USB port 1

.8 USB-1 – to indicate if a supported device is connected, no device is connected, or an unsupported device is connected on USB port 2

.9 FC BUS-# – to indicate if communication is occurring on FC Bus port # (1 or 2)

.10 FC EOL-# – to indicate if the end-of-line termination switch # (1 or 2) is on or off

.2 Network Automation Controller – Large, Dual Trunk

.1 The NAC shall support up to 200 supervised devices across all supported integrations.

.2 Communications Ports – The NAC(s) shall provide the following ports for connecting networkable devices

.1 Two (2) USB ports

.2 Two (2) RS-485 ports

.3 One (1) Ethernet port

3.5. DATA COLLECTION AND STORAGE

.1 The NACS shall have the ability to collect data for any property of any object and store this data for future use.

.2 The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

.1 Designating the log as interval or deviation.

.2 For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

.3 For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

.4 For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

.5 Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

.3 All log data shall be stored in a relational database in the NAC and the data shall be accessed from the HWDSB BAS server or through a standard Web browser.

.4 All log data, when accessed from the HWDSB server, shall be capable of being manipulated using standard SQL statements.

.5 All log data shall be available to the user in the following data formats:

.1 HTML

.2 XML

.3 Plain Text

.4 Comma or tab separated values (CSV)

.6 Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

.7 The NAC shall have the ability to archive its log data either locally (to itself), or remotely to the HWDSB a server. Provide the ability to configure the following archiving properties, at a minimum:

.1 Archive on time of day

.2 Archive on user-defined number of data stores in the log (buffer size)

.3 Archive when log has reached it's user-defined capacity of data stores

.4 Provide ability to clear logs once archived

3.6. AUDIT LOG

.1 Provide and maintain an Audit Log that tracks all activities performed on the NACS. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

.1 Time and date

.2 User ID

.3 Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

3.7. DATABASE BACKUP AND STORAGE

.1 The NACS shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

.2 Copies of the current database and, at the most recently saved database shall be stored in the NACS. The age of the most recently saved database is dependent on the user-defined database save interval.

.3 The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

3.8. WEB BROWSER CLIENTS

.1 The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

.2 The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.

.3 The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

.4 The Web browser client shall support at a minimum, the following functions:

.1 User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

.2 Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

.3 HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user has proper authorization.

.4 Storage of the graphical screens shall be in the Network Area Controller (NACS), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

.5 Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

.6 Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

.1 Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

.1 Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

.2 Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

.2 Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

.3 View logs and charts

.4 View and acknowledge alarms

.5 Setup and execute SQL queries on log and archive information

.7 The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

.8 Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

3.9. CENTRAL BMS SERVER FUNCTIONS

.1 The HWDSB BMS Server shall support all Network Area Controllers (NACS) which are remotely- connected to HWDSB’s enterprise network. In this configuration, each NACS can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) Interface.

.2 The server shall provide the following functions, at a minimum:

.1 Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

.2 Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NACS in the network, local or remote.

.3 The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NACS).

.4 The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.

.5 The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

.6 The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

.7 The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.

.8 Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

.9 The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:

.1 Routing of alarms to display, printer, email and pagers

.2 View and acknowledge alarms

.3 Query alarm logs based on user-defined parameters

.10 The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:

.1 Viewing and printing log data

.2 Exporting log data to other software applications

.3 Query log data based on user-defined parameters

3.10. SYSTEM PROGRAMMING

.1 The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

.2 A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

.3 Programming Methods

.1 Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

.2 Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

.3 The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

.4 All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

.5 The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

3.11. OBJECT LIBRARIES

.1 A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

.2 The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

.3 In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

.4 All control objects shall conform to the control objects specified in the BACnet specification.

.5 The library shall include applications or objects for the following functions, at a minimum:

.1 Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on- off events.

.2 Calendar Object.. The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

.3 Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals

.4 Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.

.5 Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un- occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

.6 Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand- limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

.7 The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

.8 Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

.9 Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.

.10 Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.

.11 Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.

.12 PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow

.13 proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

.14 Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

.15 Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

.16 Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC- like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

.17 Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

.18 Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

.19 Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

.6 The object library shall include objects to support the integration of devices connected to the Network Area Controller (NACS). At a minimum, provide the following as part of the standard library included with the programming software:

.1 For BACnet devices, provide the following objects at a minimum:

.1 Analog In

.2 Analog Out

.3 Analog Value

.4 Binary

.5 Binary In

.6 Binary Out

.7 Binary Value

.8 Multi-State In

.9 Multi-State Out

.10 Multi-State Value

.11 Schedule Export

.12 Calendar Export

.13 Trend Export

.14 Device

.2 For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

.3 For BACnet devices, provide the following support at a minimum

.1 Segmentation

.2 Segmented Request

.3 Segmented Response

.4 Application Services

.5 Read Property

.6 Read Property Multiple

.7 Write Property

.8 Write Property Multiple

.9 Confirmed Event Notification

.10 Unconfirmed Event Notification

.11 Acknowledge Alarm

.12 Get Alarm Summary

.13 Who-has

.14 I-have

.15 Who-is

.16 I-am

.17 Subscribe COV

.18 Confirmed COV notification

.19 Unconfirmed COV notification

.20 Media Types

.21 Ethernet

.22 BACnet IP Annex J

.23 MSTP

.24 BACnet Broadcast Management Device (BBMD) function

.25 Routing

4 EXECUTION

4.1. INSTALLATION

.1 All work described in this section shall be performed by BAS/BMS system integrators or contractors that have a successful history in the design and installation of integrated control systems. The BMS integrator shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.

.2 Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

.3 Drawings of the BAS network are diagrammatic only and any apparatus not shown, but required to make the system operative as per the Consultant's design, shall be furnished and installed without additional cost to HWDSB.

.4 Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Contractor.

4.2. WIRING

.1 All electrical control wiring and power wiring to the NACS, DDCs, sub-modules, and BAS network components shall be coordinated by the BAS/BMS integrator to the Division 26 Contractor.

.2 All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All BMS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 26) unless otherwise allowed by the National Electrical Code or applicable local codes. Where BMS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

.3 All HVAC equipment that are integrated to the BAS (Boiler, Pumps, Air Handling Units, Exhaust Fans, etc.) shall have provisions for a Hand-Off-Auto (HOA) Isolator Switch. This HOA switch serves to isolate the equipment to local full stand-alone control ("Hand" position), in the event that the BAS control fails. However, in normal conditions - all BAS integrated equipment shall be set back to BAS controls ("AUTO" switch position). Magnetic Starters shall be included in the BAS Design take-off.

.4 All BAS sensors and field instrumentation devices, shall be installed independently with the existing HVAC field instrumentation control devices. This scheme is to ensure that all HVAC equipment should still operate normally, even when the BMS is not in "AUTO" mode. Critical control devices like 3-way motorized valves, shall have the option to be operated (open-close) manually, should the BMS control fail.

.5 Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

.6 Within this period, upon notice by HWDSB, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the BAS/BMS Integrator at no expense to HWDSB.

4.3. CONTROL PANELS

.1 All BAS control panels shall be interconnected on a true multi-user, peer to peer network allowing panels to exchange functionality and data. The network shall allow points sensed at one panel to be functionally shared with other control panels – e.g. one common outdoor sensor will be used per site and all control panels shall have access to this temperature throughout the LAN.

.2 All control panels shall have the ability to operate completely and independently, regardless of status of other panels, servers, or the control network status.

.3 All functions of each control panel shall be fully-re-programmable, locally at the panel, any assigned local user interface device or even remotely.

.4 Controller Digital Input and ratings as follows:

.1 Digital output contacts minimum rating at 24VAC, 500 mA.

.2 Analog output signals standard at 4-20mA, 2-10VDC, or 1-5 VDC

.3 Digital input signal shall accept Form-C dry contacts or low voltage sensing.

.4 Analog input signal shall accept a standard 4-20 MA, 2-10 VDC signals.

.5 Controllers shall have real-time clock (year, month, days, hours, minutes and seconds) capable of maintaining the time and date even during power outages.

.6 Provide non-volatile memory (NVRAM) and non-volatile PROM memory (EEPROM, battery-backed RAM or FLASH EPROM) for all control parameter storage.

.7 Local control panel communications shall have a minimum speed of 9600 bps. Remote communication shall be through served web-pages over HWDSB LAN/WAN. Communication to the control panel via the network must not lockout the local user interface (i.e concurrent access via LAN and local interface must be supported.

.8 Control panels and peripheral equipment shall operate in the following environmental conditions:

.1 Temperature: 0 ~ 50 C

.2 Relative Humidity: 10% ~ 90% (non-condensing)

.9 Install control panels in NEMA 1 or NEMA 12 enclosures wherever applicable. Doors shall be hinged provided with a master key. Provide an un-switched duplex power receptacle in each enclosure for service purpose. All new control panel enclosures shall have a minimum 25% free space for future expansion.

4.4. VARIABLE FREQUENCY DRIVE (VFD)

.1 All equipment with variable frequency drives shall be monitored by the BAS and provided control functions as required by HWDSB. Refer to VFD specifications Div 26.

4.5. WARRANTY AND SYSTEM ACCESS

.1 HWDSB shall grant the BAS/BMS integrator reasonable system access to the BAS, locally or from a remote VPN access location, for diagnostics and troubleshooting purposes, during the warranty period of the installed BAS – any vendor VPN access thereafter, shall be upon the sole review and approval by HWDSB.

.2 The BAS/BMS integrator, shall endorse the default “system platform” and “station” access to the authorized HWDSB BAS/BMS Energy System Manager for system administration and management.

4.6. SOFTWARE LICENSE

.1 As required, the BMS Contractor shall provide software licenses in the name of the owner for programming, configuration and graphics building tools to allow designated representatives to make changes, modifications or additions to the system. While future updates or revisions may require an update fee, the owner shall incur no additional cost if they choose not to update. Systems that require any annual or time-limited licensing fees shall not be permitted.

4.7. ACCEPTANCE AND TESTING

.1 Upon completion of the installation, the BAS/BMS integrator shall load all system software and start-up the system. He shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with the design specifications and to the full-satisfaction of HWDSB or its designate. The Division 23 and 16 contractors are to coordinate the checkout of the system such that each Division has a representative present during system checkout.

.2 The Division 23 contractor shall perform tests to verify proper performance of components, routines,and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation. The BAS/BMS integrator contractor shall have a representative present during system checkout by the Division 23 contractor.

.3 Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the HWDSB appointed representative. Do not delay tests so as to prevent delay of providing thermal comfort, healthy, and safe environment to HWDSB residents.

.4 System Acceptance: Satisfactory completion is when the BAS/BMS integrator together with the Division 23/ 16 contractors, have performed successfully all the required testing to show performance compliance with the requirements of the Design Specs as reviewed by the Consultant, and to the satisfaction of the HWDSB's appointed representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

4.8. OPERATOR INSTRUCTION, TRAINING

.1 During system commissioning and at such time acceptable performance of the BAS hardware and software has been established, the BAS/BMS integrator shall provide on-site operator training to HWDSB authorized personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

.2 Provide 32 hours of instruction to the owner's designated personnel on the operation of the BAS and describe its intended use with respect to the programmed functions specified. Operator orientation of the BAS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

.3 The training shall be in three sessions as follows:

.1 Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

.2 First Follow-Up Training: One day (8 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

.3 Warranty Follow Up: One day (8 hours total) in no less than 4 hour increments, to be scheduled at the request of the HWDSB during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

4.9. COMMISSIONING

.1 Commissioning Authority: Agency will act as the project Commissioning Authority. This firm will be responsible to manage and administrate the commissioning process on this project.

.2 The contractor shall be responsible for providing a functioning & fully commissioned system and carry out the following:

.1 Certify installation of equipment

.2 follow installation recommendations of all equipment suppliers

.3 start-up and commission installation of equipment & related controls.

.4 carry-out onsite performance verification tests.

.5 demonstrate operation and maintenance to owner representative and

.6 Obtain sign-off prior to substantial completion

.3 BAS Commissioning requires the participation of Division 25 contractor to ensure that all systems are operating in a manner consistent with the Contract Documents:

.4 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

5 SEQUENCES OF OPERATION

5.1. SUMMARY

.1 The Division 23 and Division 26 contractors shall provide the necessary controller (e.g. boiler sequencer) and local control devices, in order to operate all HVAC equipment in stand-alone (MANUAL) mode, in the event that the BAS encountered any malfunction or failure while in the AUTO mode.

.2 The BAS/BMS integrator shall determine what level of control the Network Area Controller, must provide with reference to the System Design. It is the responsibility of the BAS/BMS integrator to coordinate control functions, such as scheduling and supervisory-level global control with the Division 23 contractor or Consultant.

.3 The BAS System shall not interfere with the operation of the HVAC System during occurrence of a Fire Alarm signal. The required local hardwire interlock with fire alarm sensing devices shall be the responsibility of the Division 26 and 17 contractors. The BAS/BMS Integrator shall closely coordinate with the other contractors to clarify the BAS sequence of operation, during a Fire Alarm.

.4 The sequences of operation shall be as indicated.

6 BAS POINT PARAMETERS

6.1. BAS INPUT/OUTPUT POINT SCHEDULE

.1 The BAS/BMS Integrator shall determine the required sub-system points for integration and control from the Design Specs, in close-coordination with the Mechanical Divisions.

.2 Refer to mechanical drawings for control point list.

.3 All the main controllers must have minimum of 25% spare capacity for future expansion. Add additional controller/expansion module if required.

6.2. POINT REPORTING ACCURACY

.1 The BAS system shall report values with minimum end-to-end accuracy listed in Table 1.

TABLE 1

Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15ºC (±0.25ºF)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

.2 Note 1: 10% - 100% of scale

.3 Note 2: For both absolute and differential pressure

.4 Note 3: Not including utility-supplied meters

6.3. CONTROL STABILITY AND ACCURACY

.1 Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 2

Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

7 POINT NAMING CONVENTION

7.1. DEFINE BAS POINTS ACCORDING TO THE FOLLOWING NAMING CONVENTIONS:

.1 Point names should be as descriptive as possible within character length constraints of the control system.

.2 Each point name shall include the four (4) mnemonic elements: **Equipment**; **System/Descriptors**; **Parameter;** and the **Device** wherever possible.

.3 Example:

.1 Point Description: Boiler number 1 Hot Water Supply Temperature

.2 BMS Point Mnemonic: B1HWSTemp

.4 The System integrator shall seek HWDSB's advice for any ambiguities or omission from this required point naming convention, and under no circumstances shall the System integrator proceed without the approval from HWDSB.

Table: Point Schema

Equipment	Mnemonic	System /Descriptors	Mnemonic	Parameter	Mnemonic	Device	Mnemonic
Boiler	B	Hot water	Hw	Supply	S	Damper	Dmp
Chiller	Ch	Chilled Water	Chw	Return	R	Actuator	Act
Cooling tower	Ct	Domestic Hot Water	Dhw	Supply air	Sa	Photo cell	Pcell
Pump (w/ no.)	P*n*	Domestic Cold Water	Dcw	Exhaust air	Ea	Cooling valve	ClgVlv
Pump (w/o no.)	Pmp	Sump System	Sump	Mixed air	Ma	Heating valve	HtgVlv
Tank	Tnk	Ramp Heating	Rmp	Outdoor air	Oa	Filter	Flt
Water heater	Whtr	Lighting	Ltg	Return air	Ra	Sensor	Senr
Heat exchanger	Hx	Garage	Grg	Gas	Gas		
Roof Top Unit	Rtu	Basement	Bsmt	Temperature	Temp		
Air handling unit	Ahu	Room	Rm	Differential Pressure	Dp		
Supply fan	Sf	Interior	Int	Enable	En		
Exhaust fan	Ef	Exterior	Ext	Alarm	Alm		
Solar wall	solwal	North	N	Start/stop	St/Stp		
Solar water heater	solwhtr	South	S	Status	Sts		
Unit heater	Uhtr	East	E	Carbon Monoxide	CO		
Terminal htr	Thtr	West	W	Occupancy	Occ		
Condenser	Cnd	Space	Spc	Setpoint	Spt		
Evaporator	Evp	Dx Control	Dx	High limit	HL		
Solar wall	solwal	Zone	Zn	Low limit	LL		

8 BMS/BAS SYSTEMS AND CONTROL DEVICES

8.1. APPROVED CONTROLS VENDORS

.1 Johnson Controls - Metasys (Branch Office)

.2 Siemens - Insight

.3 Convergint - EcoStruxure

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1, Division 22 and Division 23.

1.2. REFERENCES (LATEST REVISIONS)

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 61010-1.

.2 CAN/CSA-C22.3 No. 1, Overhead Systems.

.3 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.3 Ontario Electrical Safety Code

.4 Ontario Building Code

1.3. DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122-2000.

1.4. DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.4 Language operating requirements: provide identification labels for control items in English.

1.5. SUBMITTALS

.1 Submittals: in accordance with Division 01 – General Requirements.

.2 The Contractor is required to make submissions as follows:

.1 Prepare a schedule of shop drawings, not later than four weeks after the award of the Contract, indicating drawing submission and equipment delivery dates.

.2 Allow 7 working days for review by our office.

.3 Submit data on originals or good clear photocopies applicable only to equipment or systems being supplied. Do not submit general data covering a range of products. Clearly mark or highlight items being supplied, normal and optional accessories.

.4 Faxed copies of shop drawings will NOT be acceptable.

.5 Shop Drawings shall clearly indicate the identification number used on the drawings or schedules. In addition, the materials and/or equipment being supplied require accurate dimensions, capacity, operating characteristics and performance data as described in the specifications and listed in equipment schedules.

.6 Submit complete packages by system (i.e. all panel bords, starters, conduits) and including all necessary information to allow for complete review of submitted shop drawings and associated system.

.7 Shop Drawings being submitted where the size, capacity or voltage are different from the specified piece of equipment, the specified data and alternate data must be highlighted on the front cover sheet.

.8 “Resubmit” Shop Drawings or Shop Drawings requiring additional information will have to be forwarded or returned to our office in a timely fashion to allow time for review again, along with revised scheduling or delivery date changes as a result of having to provide additional information or resubmission.

.9 Shop Drawings shall be accompanied by a completed copy of the attached “Shop Drawing Submittal Sheet”. The submittal sheet shall be used for stamping by the Contractors and Consultants.

.10 Shop Drawings must bear the stamp and signature of the submitting Sub-Contractor as well as the General Contractor to indicate that the Shop Drawings or Catalogue Cuts are in conformance with all requirements of the drawings, that they have coordinated this equipment with other equipment which is related and/or connected and that they have verified all dimensions to ensure the proper installation of equipment including recommended service space and without interference with the work of other trades. Ensure that mechanical and electrical co-ordination is complete before submitting drawings for review. Incomplete or improperly submitted shop drawings will be rejected.

.11 In addition to project identification, date, etc., the form of stamp used in drawings review will contain the following format:

Drawing: Review ( )

Reviewed As Noted ( )

Revise and Re Submit ( )

Not Reviewed ( )

.12 This stamp to be applied by the Consultant to each and every shop drawing.

.13 This review by the Consultant is for the sole purpose of ascertaining conformance with the design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which to remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of other interfacing Trades as well as compliance with codes and requirements of Authorities.

.1 Samples:

.1 Submit samples representative of material to be delivered to site if requested by Engineer including but not limited to:

.1 Wires and Cables

.2 Connectors and Terminations

.3 Outlet Boxes

.4 Identification and equipment tag samples

.5 Other items as requested by the Consultant

.2 Co-ordination/Installation Drawings:

.1 The Contractor is required to prepare drawings in conjunction with all other trades concerned, showing sleeves and openings for passage through structure and all inserts, equipment bases and supports, and relate these to suitable grid lines and elevation datum.

.2 Prepare co-ordination drawings for all areas where the work of other Divisions 21, 22, 23, 26 and/or 27 and 28 could conflict with and/or obstruct the work of other trades and/or other Sections of this Division. Submit drawings for review by the Consultant.

.3 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.

.4 In addition to transmittal letter referred to in Division 01 – General Requirements:

.1 Identify section and paragraph number.

.2 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Division 01 – General Requirements

.2 Closeout is including not limited to ESA inspection in addition to final certificate, approved stamped shop drawings, as-built drawings mark ups [CAD or PDF, hand drawn is not acceptable], Fire Alarm verification report, red-line drawings and warranty letter.

.3 Autocad & PDF as built drawings to be provided by consultant incorporating as built mark ups, sketches from contractor.

.3 Operation and maintenance manual approved by, and final copies deposited with, Engineer before final inspection.

.4 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 Component schedule and single line diagram.

.7 Colour coding chart.

.5 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.

.6 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 and Commissioning Reports

.7 Approvals:

.1 Submit required copies of draft Operation and Maintenance Manual to Departmental Representative and Engineer for approval.

.2 Submit required copies of draft Operation and Maintenance Manual to Owner Representative and Engineer for approval. Submission of individual data will not be accepted.

.3 Make changes as required and re-submit as directed by Owner Representative and Engineer.

.8 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.9 Site records:

.1 Consultant will provide 1 set of reproducible electrical drawings. Provide sets of white prints as required or each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing electrical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducible, revising reproducible to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.10 As-built drawings:

.1 Prior to start of Testing and Commissioning 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 ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Engineer for approval and make corrections as directed.

.4 Perform testing and commissioning using as built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.11 Submit copies of as-built drawings for inclusion in final Commissioning report in accordance with Division 01 – General Requirements.

1.6. QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Ontario Act respecting manpower vocational training and qualification.

1.7. DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Contractor with schedule within 2 weeks after award of Contract.

1.8. SYSTEM START-UP

.1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant will aspects of its care and operation.

1.9. OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

2 PRODUCTS

2.1. MATERIALS AND EQUIPMENT

.1 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in 1.5 – **SUBMITTALS**.

.2 Factory assemble control panels and component assemblies.

2.2. ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated (if applicable).

2.3. WARNING SIGNS

.1 Warning Signs: in accordance with requirements of Consultant.

.2 Porcelain enamel signs, minimum size 175 x 250 mm

2.4. WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5. EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates: plastic laminate 3 mm, matt white finish face, black core, mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10x50 mm	1 line	3 mm high letters
Size 2	12x70mm	1 line	5 mm high letters
Size 3	12x70mm	2 lines	3 mm high letters
Size 4	20x90mm	1 line	8 mm high letters
Size 5	20x90mm	2 lines	5 mm high letters
Size 6	25x100mm	1 line	12 mm high letters
Size 7	25x100mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates to be approved by Consultant prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate.

.5 Co-ordinate names of equipment and systems with mechanical sections when they are used in project, to ensure that identical names are used.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Identify equipment with Size 3 labels engraved as directed by Consultant.

.8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.9 Terminal cabinets and pull boxes: indicate system and voltage.

.10 Transformers: indicate capacity, primary and secondary voltages.

2.6. WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system

2.7. 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.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security System	Red	Yellow

2.8. FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

3 EXECUTION

3.1. INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1

3.2. NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3. MANUFACTURER`S AND CSA LABELS

.1 Equipment and material to be CSA-certified. Where there is no alternative to supplying equipment, which is not CSA-certified, special approval to be obtained from Electrical Inspection Department.

3.4. OPERATION AND MAINTENANCE MANUALS

.1 Include the following information in the Operation and Maintenance manuals:

.1 Names and address of local suppliers for the items included.

.2 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

.3 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.

.2 Review information provided in the maintenance instructions and manual switch the Owners' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

3.5. CONDUIT AND CABLE INSTALLATION

.1 Conduits and sleeves to be installed prior to pouring of concrete.

.1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50mm.

.2 Plastic sleeves to be removed before conduit installation if used in fire rated walls or floors.

.3 Installation of cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.6. CONSTRUCTION DRAWINGS

.1 Fully dimensioned drawings to be prepared showing sleeves and openings through structure. Locations and weights on all load points to be indicated.

.2 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.

.3 Fully-dimensioned construction drawings of products and services in electrical rooms, service and ceiling spaces, and all other critical locations, to be prepared. Co-ordinate the Work with all other Divisions. Base drawings on reviewed shop drawings and indicate all details pertaining to access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevations of pipes, ducts and conduits.

.4 Construction/interference drawings to be submitted prior to commencement of work.

.5 Construction drawings are prepared for construction and record purposes only and are not part of the contract documents or shop drawings.

3.7. CUTTING AND PATCHING

.1 All cutting and patching required for the installation of new equipment and surface restoration to be done after the removal of existing equipment. Materials equal to those comprising the surrounding area to be used for patching.

.2 Be aware of fire-rated partitions, minimize the area affected by the work, and return all surfaces to condition encountered before the work.

.3 Finished surfaces shall be painted to match adjacent surfaces.

3.8. PROTECTION

.1 Building and structure to be protected from damage due to carrying out this work.

.2 All electrical work to be protected from damage. All equipment to be kept dry and clean at all times.

.3 All openings in equipment and materials to be covered.

3.9. DEMOLITION

.1 All power and systems to be made safe and disconnected, as and when, and to the extent required, to facilitate with the demolition.

.2 Ensure that all electrical, life safety services, and services for existing equipment, in areas outside the areas of this work, that are required to remain in service, shall do so.

.3 Any electrical feeders or equipment that are required to remain in service, that are secured to existing walls, floors or ceilings to be demolished or that are buried and required to be excavated for new work are to be relocated.

.4 Any electrical equipment on walls or ceilings that will be demolished and rebuilt to be removed and replaced.

.5 When deleting and/or making safe existing electrical work, ensure that it includes all wiring back to the associated panel board or control panel.

.6 Existing light fixtures, devices, outlets, etc. which are not to be reused are to be disconnected and removed. Such items shall be cartoned and turned over to the Owner at a place designated by the Owner. Unused raceway and outlets to be cut back and capped and remove unused wiring back to panel board in an approved manner.

.7 All existing equipment, which is to be reused and/or relocated, to be thoroughly inspected and refurbished to ensure correct operation when put back into service and to meet OESC approval.

.8 All existing electrical equipment which is no longer required shall be removed and disposed of off-site.

.9 Work shall be carried out with a minimum of noise, dust and disturbance.

.10 Tools and clean up equipment shall be provided. Owner's permission shall be obtained for the use of electrical, plumbing or drainage outlets.

.11 Daily clean-up and proper disposal of debris generated by daily operations shall be provided. On completion of the work, all tools, surplus materials and waste materials shall be removed, and the premises left in a clean, perfect condition.

3.10. EQUIPMENT SUPPORTS, ANCHORS AND HANGERS

.1 All supports required for the erection and support of the electrical work shall be provided.

.2 All suspended equipment shall be supported from the bottom.

.3 All lintels shall be provided where required.

.4 All hangers shall be suspended directly from the structure using approved inserts or beam clamps.

.5 Pipe hooks, or perforated straps shall not be used.

.6 Hangers shall be spaced such that there is a hanger within 610mm (24”) of every bend and that the maximum spacing does not exceed the limits indicated in Ontario Hydro Electric Power Commission (OHEPC) code.

.7 Vertical pipes shall be supported at each floor slab and at the top and bottom of each riser.

.8 All conduit or cable shall be supported at equipment mounted on spring isolators, with spring hangers for at least 4572mm.

.9 Any conduits supported from ductwork, pipes, etc. shall not be allowed.

3.11. EXPANSION JOINTS AND LOOPS

.1 Expansion joints or loops in conduits crossing expansion joints in the structure shall be provided without imposing undue stress on structure, apparatus or conduit.

3.12. FINISHES

.1 Metal enclosure surfaces to be shop finished by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.2 Surfaces of shop-painted equipment scratched or marred during shipment or installation, to be cleaned and touched up to match original paint.

.3 Exposed non-galvanized hangers, racks and fastenings to be cleaned and primed to prevent rusting.

3.13. FIRESTOPPING

.1 Firestopping and smoke seal to be provided where cable, bus ducts, cable tray or conduits pass through floors and fire-rated walls.

3.14. LOAD BALANCE

.1 Measure phase current to panelboards with normal loads operating at time of acceptance. Branch circuit connections to be adjusted as required to obtain best balance of current between phases and record changes.

.2 Phase voltages to be measured at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 A report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load to be submitted at completion of work. Hour and date on which each load was measured, and voltage at time of test to be indicated

3.15. LOCATION OF OUTLETS

.1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.3 Locate light switches on latch side of doors.

.4 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.16. MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise:

.1 Local switches: 1100 mm.

.2 Wall receptacles:

.1 General: 500 mm.

.2 Above top of continuous baseboard heater: 200 mm.

.3 Above top of counters or counter splash backs: 175 mm.

.4 In mechanical rooms: 1400 mm.

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and interphone outlets: 500 mm.

.5 Wall mounted telephone and interphone outlets: 1100 mm.

.6 Fire alarm stations: 1100 mm.

.7 Fire alarm bells: 2100 mm.

.8 Television outlets: 500 mm.

.9 Wall mounted speakers: 2100 mm.

.10 Clocks: 2100 mm.

.11 Doorbell pushbuttons: 1100 mm.

3.17. CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.18. FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in Section 1.5 SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centers, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 26 08 00 – Commissioning.

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system] and communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Consultant.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 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 Section 1.5 - 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 Section 1.6 - QUALITY ASSURANCE.

3.19. RECORD OF DRAWINGS

.1 The Consultant shall provide the Contractor with two extra sets of white prints on which the contractor shall clearly mark, as the job progresses, all changes and deviations from that shown on contract drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include variation orders, field instructions and all other changes. After inspection and approval of service lines in trenches, the contractor shall take as-built measurements, including all depths, prior to backfilling operations. It will not be sufficient to check off line locations. Definite measurements shall be taken for each service line. The location of buried duct banks, etc. shall be shown on the drawings from fixed points. On completion of the building, the contractor shall forward to the Consultant the two sets of drawings indicating all such changes and deviations for review. Include in the tender price, the cost for the production of CAD CD record drawings by the Consultant's staff.

3.20. SINGLE LINE ELECTRICAL DIAGRAMS

.1 Single line electrical diagrams to be provided under Plexiglas.

.2 Fire alarm riser diagram, plan and zoning of building shall be provided under Plexiglas at fire alarm control panel and annunciator.

.3 Drawings: 610mm x 610mm minimum size.

.4 Single line diagram show adheres to IEEE 315 graphics and IOs CAD standard

3.21. TAGS AND DIRECTORY

.1 After finished painting is completed, each main feeder cable and conduit service to be identified. Locate identification:

.1 Behind each access door.

.2 At each change of direction and at junction boxes.

.3 At not more than 12 meters apart in straight runs of exposed conduit, but on both sides of sleeves.

.4 At not more than 12 meters apart in straight runs of conduit behind removable enclosures such as lay in type ceiling, cut on both sides of sleeves.

.2 Stencils and stencil paint, or lemuroid plates, to be used on all conduit and ductwork.

.3 Use letters a minimum of 25mm high.

.4 The identification shall describe system voltage and services; e.g. "120/208 Volt lighting fed from panel 2A".

.5 Conduits and outlet boxes for the various systems shall be identified by the use of distinctive colour paints. Colour for each system shall match the existing colour code on site. In the event that there is no existing colour code for a particular system on site, the following colours shall be used subject to approval from the Owner:

.1 120/208 Volt System – Yellow

.2 Telephone Conduit System – Green

.3 Intercom and Low Voltage Signal Systems – Black

.4 Emergency System – Orange

.6 All equipment to be identified with lamacoid plastic plates, white background with black engraved letters 6mm (¼") high. An itemized list of all name tag wording to be submitted to Owner for approval.

.7 Lighting and Power Panels: Plates to be mounted on door. Typical identification: "Lighting Panel 3A, 347/600 Volt, 3 Phase, 4-Wire". Identify source of power: "Supplied from Main Switchboard".

.8 Disconnect Switches and Starters: Plates to be mounted externally on switch box cover. Typical Identification: "Fan S4, 208 Volt, 3 Phase".

.9 Plates shall be installed after all painting has been completed and shall be secured with mechanical fastening devices, except on the inside of panel doors where gluing will be accepted.

.10 Manufacturer's nameplate to be affixed to each item of all equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, frequency, # of phases, horsepower, etc., and the name of the manufacturer and his address. Ensure that all stamped, etched and engraved lettering on plates is perfectly legible. Ensure that nameplates are not painted over. Where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.

.11 All equipment to be identified with the corresponding remote controls.

.12 Panels and other apparatus which have exposed faces in finished areas are to be ensured to not have any visible trademarks or other identifying symbols. Nameplates to be mounted behind doors.

.13 All outlet boxes provided in the ceiling space for future lighting and/or power connections shall be identified on the box cover with Brady selfsticking markers indicating circuits contained in the box.

3.22. VIBRATION ISOLATION

.1 Vibration isolation control shall be provided as necessary so as to prevent transmission of objectionable vibration to the building structure, and from one area to another.

.2 All steel bases and concrete inertia pads shall be provided. All bases to be installed to clear the sub base (housekeeping pads) by minimum 25mm for steel bases, and 50mm for concrete bases.

.3 All floor mounted equipment shall be erected on 102mm high reinforced concrete pads. Concrete pads shall be of similar dimensions to that of the foot print of the equipment. Wherever vibrations eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted upon the 102mm high reinforced concrete pads; unless specified to the contrary.

.4 All concrete foundations and supports shall be provided by this division. The contractor shall provide dimensioned drawings and details of all such work required and shall submit same to the Consultant for approval.

3.23. WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

3.24. GUARANTEE

.1 The Contractor shall furnish a written guarantee, countersigned, stating that all work executed under this division will be free from defects of materials and workmanship for a period of one year from the date of final acceptance of this work. The above Contractor further agrees that he will, at his own expense, repair, and replace all such defective work, and all other work damaged during the process of repair during the term of the warranty period, except where damage is due to negligence on the part of the Owner.

.2 All extended guarantees to be furnished for equipment requiring same in the specifications.

3.25. COMPLETION

.1 All fixtures and equipment shall be cleaned. All plated surfaces shall be polished.

.2 All relays to be set to operating condition.

.3 All temporary protection and covers to be removed.

.4 Inside of switchgear, panelboards, motor control center, and fire alarm control panel and annunciators to be vacuum cleaned and ensured to be free from debris and dust.

.5 All lamps to be changed, and to be new at time of system acceptance.

.6 Leave electrical work in as new working order.

3.26. 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. GENERAL REQUIREMENT

.1 Conform to section 26 05 00,

.2 Acceptable vendors are equipment manufacturer, Enkompass Power and Energy Corp

PART 2 PRODUCTS

2.1. MATERIAL AND DESIGN REQUIREMENTS

.1 General

.1 The engaged consultant shall review and validate the short circuit analysis and protective device coordination studies as prepared by the equipment manufacturer for all electrical protective devices to verify each device can safely withstand and interrupt the available fault currents.

.2 Coordination information shall be shown on a graphical chart in log-log format for all applicable low voltage devices and for all devices used for Medium Voltage protection. All device settings shall be indicated either on the chart or accompanying the chart.

.3 The maximum allowable Arc Flash Hazard category for any part within Medium Voltage unit substations shall not exceed level 2 (8 cal/cm^2) as per Section 26 11 13 Primary Unit

.4 Substations, 2.1.9 and 2.13.

.5 The engaged consultant shall review and validate the Arc Flash hazard analysis for all applicable components of the project's electrical distribution system per CSA Standard Z462.

.6 The engaged consultant shall ensure that every effort is given to minimize the Arc Flash Hazard category while maintaining selective device coordination. Reduce distribution transformer sizes or incorporate circuit breakers with LSI capabilities to achieve a maximum of 8 cal./cm sq. at all switches, circuit breakers and MCCs.

.7 The Arc Flash hazard analysis shall clearly indicate the Incident Energy, Arc Flash protection boundary and Hazard Category for each applicable device.

.8 All documentation shall be in colour and provided in soft copy PDF format. Scanned copies shall not be permitted.

PART 3 EXECUTION

3.1. NOT USED

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 This Section includes requirements for selective demolition and removal of electrical and communications components including removal of conduit, junction boxes, and panels to source home run removal and incidentals required to complete work described in this Section ready for new construction.

1.2. REFERENCE STANDARDS (LATEST REVISIONS)

.1 Canadian Standards Association (CSA)

.1 CSA S350 M1980, Code of Practice for Safety in Demolition of Structures.

1.3. DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.3 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

.4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.

.6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4. ACTION AND INFORMATIONAL SUBMITTALS

.1 Action Submittals: Provide in accordance with Section 01 33 00– Submittal Procedures before starting work of this Section.

1.5. ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

1.6. SITE CONDITIONS

.1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition [on date that tender is accepted].

.2 Existing Hazardous Substances: Owner performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in Work.

.3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Consultant if materials suspected of containing hazardous substances are encountered and perform following activities:

.1 Hazardous substances will be as defined in Hazardous Products Act.

.2 Stop work in area of suspected hazardous substances.

.3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.

.4 Hazardous substances will be removed by Owner under a separate contract or as a change to Work.

.5 Proceed only after written instructions have been received from Consultant.

2 PRODUCTS

2.1. NOT USED REPAIR MATERIALS

.1 General Patching and Repair Materials:

.2 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.

.3 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2. SALVAGE AND DEBRIS MATERIALS

.1 Material Ownership: Demolished materials become Contractor 's property and will be removed from Project site; except for items indicated as being reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property.

.2 Salvaged Materials: Carefully remove materials designated for salvage and store in a manner to prevent damage or devaluation of materials and as follows:

.1 Leave main electrical distribution panel in place; panel can be used for temporary construction power for this project scope and subsequent contracts in accordance with Section 01 51 00– Temporary Facilities; coordinate temporary power connections with HWDSB. A written approval from HWDSB is required prior to commencement of this work.

.2 Leave main telephone terminal backboard in place; panel can be used for temporary construction telephone system for this project scope and subsequent contracts in accordance with Section 01 51 00– Temporary Facilities; coordinate temporary power connections with HWDSB. A written approval from HWDSB is required prior to commencement of this work.

3 EXECUTION

3.1. EXAMINATION

.1 Verification of Existing Conditions: Mandatory site visit is not required. However, contractor to thoroughly examine and become familiar with conditions that may affect work of this Section prior to equipment procurement.

3.2. PREPARATION

.1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:

.1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.

.2 Notify Consultant and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

.3 Prevent debris from blocking drainage inlets.

.4 Protect mechanical systems that will remain in operation.

.2 Protection of Building Occupants: Sequence demolition work so that interference with use of the building by Owner and users is minimized and as follows:

.1 Prevent debris from endangering safe access to and egress from occupied buildings.

.2 Notify Consultant and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3. EXECUTION

.1 Removal and Demolition:

.1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.

.2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.

.3 Disconnect and remove existing fire alarm system including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.

.4 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.

.5 Disconnect and remove telephone outlets, associated conduit, cabling and sub terminal backboards and related accessories; maintain telephone service and main terminal backboard as is.

.6 Perform demolition work in a neat and workmanlike manner:

.1 Remove tools or equipment after completion of work and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

.7 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as “SPARE”.

.8 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.

.9 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.

.10 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.

.11 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4. CLOSEOUT ACTIVITIES

.1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No.65-93, Wire Connectors.

.2 National Electrical Manufacturers Association (NEMA)

.3 Ontario Electrical Safety Code

.4 Ontario Building Code

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 conductors 10 AWG or less.

.3 Bushing stud connectors to consist of:

.1 Connector body and stud clamp for round copper conductors] tube.

.2 Clamp for round copper conductors.

.3 Stud clamp bolts.

.4 Sized for conductors' tubes as indicated.

3 EXECUTION

3.1. REMOVE INSULATION CAREFULLY FROM ENDS OF CONDUCTORS AND:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 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.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors.

END OF SECTION

1 GENERAL

1.1. PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00.

1.2. STANDARDS

.1 Ontario Electrical Safety Code

.2 Ontario Building Code

.3 Provide Type TECK 90 cables in accordance with CSA Standard C22.2 No. 131.

.4 All cables installed in areas requiring fire rating shall conform to test FT-4.

.5 All cables installed in return air plenums shall conform to test FT-6.

1.3. SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC and Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC and Section 26 05 00 – Common Work Results for Electrical.

2 PRODUCTS

2.1. BUILDING WIRES

.1 Conductors:

.1 Copper conductors, of the size as indicated, having a minimum conductivity of 98 percent.

.2 Copper conductors: Stranded for 12 AWG and larger, with 1000 V insulation for 347/600 Volt systems, and 600 V insulation for 120/208 V systems, of chemically cross-linked thermosetting polyethylene material rated RW90 and/or RWU90 to CSA C22.2 No. 38.

.3 Conductors shall be minimum No. 12 AWG, size conductor for maximum 2% voltage drop to the furthest outlet on a fully loaded branch circuit.

.4 Minimum wire size shall be No. 12 AWG. Home runs to lighting and receptacle panels which exceed 24 m (80') in length shall be minimum No. 10 AWG. Home runs which exceed 40 m (120’) in length shall be minimum No. 8 AWG. Home runs which exceed 60 m (180') in length shall be minimum 6 AWG

.5 Conductors shall be colour coded. Conductors No. 10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors No. 8 AWG and larger may be colour coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

.6 Colour coding shall be as follows: Red - Phase A, Black -Phase B, Blue - Phase C, White - Neutral, Green - Ground, Orange - Control.

.7 Insulation: RW90 unless RWU90 is specified

.8 AC-90 cable is allowed for outlet & lighting fixture connection for Max 5' & not allowed from the source point directly to the device/equipment.

.2 Manufacturers: Acceptable manufacturers are:

.1 General Cable.

.2 South Wire.

.3 Nexans.

2.2. CONTROL CABLES

.1 300 V control cable: Stranded annealed copper conductors sized as indicated, with XPLE insulation with a shielding of 100% coverage of aluminum polyester tape and drain wire over each group and over all conductors.

.2 Jacket: FT4 Flame Retardant PVC or FT6 Plenum rated in open style cable trays in floor void spaces

.3 Armour: Steel (No armour required if installed in conduit or approved wireway)

.4 300 V cables shall conform to CSA standards CAN 3-C21.2 M86.

.5 Custom control cables shall be designed and assembled in the configurations as indicated.

.6 Each conductor shall be black and number coded, pairs shall be black and white and number coded.

.7 Manufacturers: Acceptable manufacturers are:

.1 Canada Wire and Cable Limited;

.2 Pirelli;

.3 Belden;

.4 Shawflex Inc.

.5 Nexans Canada Inc

2.3. MINERAL-INSULATED CABLES

.1 Conductors: solid bare soft-annealed copper, size as indicated.

.2 Insulation: compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.

.3 Outer covering: annealed seamless copper sheath, Type M1 rated 600 V, 250 degrees C.

.4 Overall jacket: PVC applied over the sheath and compliant to applicable Building Code classification for this project.

.5 Two-hour fire rating.

.6 Connectors: explosion-proof, field installed approved for MI cable.

.7 Termination kits: field installed approved for MI cable

3 EXECUTION

3.1. GENERAL

.1 Install grounding, grounded and neutral conductors without any fuses, switches or breakers of any kind unless otherwise indicated.

.2 Ground the grounded or neutral conductor at the source of supply as indicated and isolate the grounded or neutral conductor at all other locations.

.3 Do not use any grounded or neutral conductors as a grounding conductor.

.4 Do not use any grounding conductor as a grounded or neutral conductor.

.5 Do not splice any wiring in any raceway. Make splices only at junction boxes.

.6 Provide sufficient slack at the connection points of conductors to permit proper connections to be made.

.7 Do not install any conductors in any raceway until the raceway is complete and cleared of all obstructions.

.8 Install all conductors in any one (1) conduit at the same time taking care not to twist the conductors.

.9 Use wire pulling lubricants that will not shorten the life of the insulation.

.10 Do not install any wires or cables at temperatures above or below those which will cause damage to the wires or cables.

3.2. INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 32.

.2 In underfloor raceways for electrical systems in accordance with Section 26 05 39.

.3 In wireways and auxiliary gutters in accordance with Section 26 05 37.

3.3. INSTALLATION OF TECK 90 1000 V

.1 Install cables as indicated.

.2 Group cables wherever possible on channels.

.3 Lay cable in cable-troughs in accordance with Section 26 05 39.

.4 Terminate cables in accordance with Section 26 05 20.

3.4. INSTALLATION OF CONTROL CABLES

.1 Install control cables, as indicated in conduit and in cable-troughs.

.2 Ground individual pair control cable shields at the supply and only unless otherwise indicated.

.3 Ground the overall control cable shields at both ends.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.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 International)

.3 CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

.1 Ontario Electrical Safety Code

.2 Ontario Building Code

2 PRODUCTS

2.1. EQUIPMENT

.1 Clamps for grounding & Bonding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size.

.3 Grounding & Bonding conductors: bare stranded copper, tinned, soft annealed, size

.4 Insulated grounding & Bonding conductors: green, type 6 mm^2.

.5 Ground bus: copper, size, complete with insulated supports, fastenings, connectors.

.6 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.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

3 EXECUTION

3.1. INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding & bonding conductors from mechanical injury.

.4 Use mechanical connectors for grounding & bonding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 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.

.7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.8 Install grounding resistance bank.

.9 Connect building structural steel and metal siding to ground by welding copper to steel.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Ground secondary service pedestals.

3.2. 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 centers, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.3. GROUNDING BUS

.1 Existing

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.

3.4. COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.2 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.3 Sound, fire alarm, intercommunication systems as indicated.

3.5. FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISION)

.1 Ontario Electrical Safety Code

.2 Ontario Building Code

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC and Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC and Section 26 05 00 – Common Work Results for Electrical.

2 PRODUCTS

2.1. SPLITTERS

.1 Construction: distribution trough for three and four-wire distribution system with copper bars on insulators, sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 25 A.

.4 Splitter rating:

.1 125A, 600V

.2 75A, 600V

2.2. CABINETS

.1 Existing

3 EXECUTION

3.1. SPLITTER INSTALLATION

.1 Mount plumb, true and square to 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 except where indicated otherwise.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3. IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.

.2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, 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 (Unplasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

.2 Ontario Electrical Safety Code

.3 Ontario Building Code

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC and Section 26 05 00 – Common Work Results for Electrical.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

.3 Submit cable manufacturing data.

.4 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.

1.4. WASTE MANAGEMENT AND DISPOSAL

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

2 PRODUCTS

2.1. CABLES AND REELS

.1 Provide cables on reels or coils.

.2 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.3 Each coil or reel of cable to contain only one continuous cable without splices.

.4 Identify cables for exclusively DC applications.

.5 Reel and mark shielded cables rated 2,001 volts and above.

2.2. CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, 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, liquid-tight flexible metal

.6 FRE conduit: to CSA C22.2.

.7 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

2.3. CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 50 mm and smaller.

.2 Two-hole steel straps for conduits larger than 50 mm.

.3 Beam clamps to secure conduits to exposed steel work.

.4 Channel type supports for two or more conduits at 1.5 m on center.

.5 Threaded rods, 6 mm diameter, to support suspended channels.

2.4. CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Coupling to be compression type.

.4 Set screws are not acceptable.

2.5. 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.

2.6. FISH CORD

.1 Polypropylene.

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 conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Surface mount conduits except in finished areas or as indicated.

.4 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.

.5 Use epoxy coated conduit underground and in corrosive areas.

.6 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury.

.7 Use rigid PVC conduit underground.

.8 Use flexible metal conduit for connection to motors in dry areas, to recessed incandescent fixtures without prewired outlet box, to surface or recessed fluorescent fixtures, and work in movable metal partitions.

.9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.10 Use explosion proof flexible connection for connection to explosion proof motors.

.11 Install conduit sealing fittings in hazardous areas.

.12 Fill with compound.

.13 Minimum conduit size for lighting and power circuits: 19 mm.

.14 Install rigid conduit from computer room branch circuit panel to outlet boxes located in sub floor.

.15 Install rigid 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.

.16 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.17 Mechanically bend steel conduit over 19 mm diameter.

.18 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.19 Install fish cord in empty conduits.

.20 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.

.21 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.22 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.

.2 Protect conduits from damage where they stub out of concrete.

.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 Conduits in slabs: minimum slab thickness 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 encase 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.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1. SUMMARY

.1 The purpose of this section is to specify the electrical contractor's responsibilities in the commissioning process.

.2 An independent firm specializing in building systems commissioning will be retained by the Owner to act as the project Commissioning Authority (CA). This firm will be responsible to manage and administrate the commissioning process on this project.

.3 The list of commissioned equipment and systems is found in Section 01 91 13 Commissioning – General Requirements. Commissioning requires the participation of contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in the same section.

.4 Contractors shall be familiar with all parts of Section 01 91 13 Commissioning – General Requirements, 01 91 13.13 Commissioning Plan and 01 79 00.13 Commissioning – Training issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2. RESPONSIBILITIES

.1 General

.1 The responsibilities of the Project Manager, Construction manager, Architect, Mechanical and Electrical Consultants/Engineers (A/E), and Commissioning Authority in the commissioning process are provided in Section 01 91 13 Commissioning General Requirements.

.2 Include and itemize the cost of commissioning in the contract price as identified in section 01 91 13.

.2 Electrical Sub-Contract Trade(s): The commissioning responsibilities applicable to the electrical contractor are as follows (all references apply to commissioned equipment only):

.1 Construction and Acceptance Phases:

.1 Test and commission the system listed in 01 91 13 and Part 3 of this specification.

.2 Include the cost of participating in the commissioning process as outlined in the specifications in the total contract price.

.3 All parties involved must be cognizant of industry-standard safety procedures. This document does not contain any procedures including specific safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests shall be qualified and capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved.

.4 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

.5 Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.

.6 Contractors shall provide normal cut sheets and shop drawing submittals to the CA of commissioned equipment.

.7 Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures:

.1 Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.

.2 The Commissioning Authority may request further documentation necessary for the commissioning process.

.3 This data request may be made prior to normal submittals.

.8 Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review and approval.

.9 Contractors shall assist (along with the design consultants) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.10 Develop and submit a test plan using manufacturer’s start-up procedures and the prefunctional checklists from the CA (or similar) for all commissioned equipment. Submit to CA for review and approval prior to start of inspection and testing. Refer to Section 01 91 13 and this section for further details on start-up plan preparation.

.11 Provide assistance to the CA in preparing the specific functional performance test procedures as specified in Section 01 91 13 and in this section. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.12 Provide notification to the CA prior to the commencement of any electrical commissioning activity.

.13 Perform and document inspection and testing for electrical equipment and systems according to the agreed upon test plan, and using the using manufacturer's start-up procedures and the prefunctional checklists from the CA for all commissioned equipment.

.14 During the startup and initial checkout process for mechanical equipment, coordinate work with the other divisions as required to execute and document the electrical-related portions of the pre-functional checklists for mechanical equipment.

.15 Perform and clearly document all completed inspections and testing activities, including notification of any deficiencies, providing a copy to the CA prior to the start of functional testing phase.

.16 Address current A/E punch list items before the start of functional testing.

.17 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.18 Perform functional performance testing, witnessed by the CA, for specified equipment in Section 01 91 13 and in this section. Assist the CA in interpreting the inspection and testing data, as necessary.

.19 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, CM and A/E and retest the equipment.

.20 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.21 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

.22 Provide training of the Owner's operating personnel as specified.

.23 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.3 Warranty Phase:

.1 Execute seasonal or deferred functional performance testing, witnessed by the design engineers, according to the specifications. This includes deferred voltage/ load balance and power factor testing specified in this section.

.2 Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

2 PRODUCTS

2.1. TEST EQUIPMENT

.1 Contractor shall provide all test equipment necessary to fulfill the testing requirements of this section.

.2 The equipment to be provided shall include, but is not limited to:

.1 Electrical measurements: ohmmeter, voltmeter, ammeter and wattmeter;

.2 Any other equipment specified by the manufacturer to perform required testing and verification.

.3 Suitability of Test Equipment

.1 All test equipment shall meet the calibration requirements below and be in good mechanical and electrical condition.

.2 Field test metering used to check power system meter calibration must be more accurate than the instrument being tested.

.3 Accuracy of metering in test equipment shall be appropriate for the test being performed.

.4 Test Instrument Calibration

.1 The electrical contractor / designated commissioning agent shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

.2 The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.3 The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

.4 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments: Analog and digital, 12 months maximum.

.2 Laboratory instruments: 12 months maximum.

.3 Leased specialty equipment: 12 months maximum.

.5 Dated calibration labels shall be visible on all test equipment.

.6 Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.

.5 Refer to 01 91 13, Part 2 – Products for additional requirements.

3 EXECUTION

3.1. SUBMITTALS

.1 Contractor shall provide submittal documentation relative to commissioning as required in Part 1 of this section, 01 91 13 Commissioning - General Requirements, and the Commissioning Plan.

.2 Generally, the following shop drawing submittals (for new equipment) are required as related to the commissioning process:

.1 All LV Distribution Equipment

.2 Panelboards

.3 Motor Control Centres (MCC)

.4 Wiring Devices

.3 Additional technical submittals shall be provided as requested at the initial commissioning meetings and dependent on the technical scope of the project.

.4 The shop drawings are reviewed by the CA for commissioning purposes only and this process is separate to the Engineer's review.

.5 The Transfer Scheme (or generator or ATS) submittal shall include a sequence of operation showing the starting sequence of generators and transfer switches on loss of power and resumption. This shall include any load shedding required.

3.2. START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

.1 General

.1 The sub-contract trades shall follow the start-up and initial checkout procedures listed in this section, in 01 91 13 and in Division 26.

.2 The following system start-up procedures are presented as a minimum standard of acceptance to validate the commissioning of the identified systems. Requirements listed in the electrical consultant's specification sections may differ from the requirements listed below. The most onerous requirements shall be carried by the contractor in all cases

.2 Distribution Cables

.1 Check cables are properly installed, terminated and tightened to the correct torque values.

.2 Check and record cable sizes, types and method of installation.

.3 Check and confirm the installed cable sizes are of adequate rating, taking into consideration the type of cable, the method of installation, the correction factors and any other requirements.

.4 Grounding test to ensure the equipment, the conduit and the cable armour / sheath, if applicable, are properly grounded.

.5 Prior to energizing any portion of the electrical system perform insulation resistance test on all feeders and all circuits as directed by code. Test to include phase to phase and phase to ground using appropriate DC test level for voltage level of equipment. Result to conform to the Canadian Electrical Code, to the satisfaction of the Local Inspection Authority having jurisdiction, and to the Engineer.

.6 Check and measure voltage and current. For cables in parallel, measure load current on each cable.

.3 Distribution Panelboards and Branch Circuit Panelboards

.1 Check and record nameplate data.

.2 Check and report the panel enclosure is suitable for the environment in which it is installed.

.3 Check cables are properly installed, terminated and tightened to the correct torque values.

.4 Check and test to verify the panelboard directory is correct.

.5 Include the directory in the test records. The directory shall contain the size of each breaker, equipment served, cable type and size.

.6 Check and test the voltage drop is within the specified limit from the service entrance switchboard to the distribution panels and branch panelboards.

.7 Test branch circuits voltage drop is within the requirements.

.8 Grounding test to ensure panelboards are properly grounded.

.9 Insulation resistance (Megger) test.

.10 Set all protective devices to the settings as per the approved Coordination Study.

.11 Test and calibrate the protective devices by secondary current injection. Record the magnitude of the test current, the actual tripping time, and the tripping time from curve.

.12 Measure voltage and load current on each phase. Submit test reports to Consultant. When required, re-arrange branch circuits as directed by the Consultants for proper load balancing.

.4 Coordination Study and On-Site Testing

.1 Vendor shall, in accordance with the approved Coordination Study, set up all the protective devices, check and verify the frame size; rating of the breakers, relays, switches and types of fuses and record all such ratings and settings in his reports.

.2 Vendor shall test and calibrate, by secondary injection, all protective devices as per the settings recommended in the study.

3.3. FUNCTIONAL PERFORMANCE TESTING

.1 General

.1 Refer to Section 01 91 13 for a list of systems to be commissioned and to Division 26 technical specifications for a description of the process and for specific details on the required functional performance tests.

.2 Division 26 is responsible for all installation, inspections and testing required to complete systems and sub-systems to ensure that they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and Functional Testing requirements listed under f this section do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Authority or Owner

.3 Functional testing is intended to begin upon completion of the start- up stage. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CA and Contractor.

.4 The functional performance testing phase shall not commence until the Start-Up activities have been completed to the satisfaction of the CA. Beginning functional testing prior to completion of start-up does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible

.2 LV Switchboards

.1 Check and test phase sequence, voltages and load on the system and on each feeder. For multi-section boards with different sources, check the phase sequences, voltages and the polarity of each source on each section.

.2 Ensure proper operation of all breakers as calculated in the coordination study. Complete report to be submitted to the Consultant within 7 days of completion of testing.

.3 Upon completion of functional testing, and again immediately prior to the final review, check the load balance on all feeders at distribution centres, motor control centres and panel boards. Tests to be performed by turning on all possible loads in the project and checking load current balance. If load unbalance exceeds 15%, report to the engineer and seek direction on reconnecting circuits to balance load.

.3 Emergency Power Operation of Critical Systems

.1 Initiate emergency power mode to verify mechanical systems (as applicable) and any other critical building systems operation on loss of normal power and return to normal power.

3.4. TESTING DOCUMENTATION, NON-CONFORMANCE, AND APPROVALS

.1 Refer to Section 01 91 13 for specific details on non-conformance issues relating to pre-functional checklists and tests.

.2 Refer to Section 01 91 13 for issues relating to functional performance tests.

3.5. OPERATION AND MAINTENANCE (O&M) MANUALS AND SYSTEMS MANUALS

.1 Contractor shall compile and prepare documentation for all equipment and systems covered in the Division 26 sections of the Performance Specification documents.

.2 Contractor shall deliver O&M documents according to Section 01 91 13 Commissioning General Requirements and other applicable sections of the Performance Specification documents.

.3 The CA shall receive a copy of the O&M manuals for review

.4 Where required the contractor shall provide the following information to the CA to assist in compilation of the Systems Manual. The CA is responsible for production of the Systems Manual. Information to be provided by the contractor includes:

.1 Approved equipment submittals including Sequence of Operation.

.2 Contractor & Supplier listing with contact information.

.3 Copy of all permits and certificates.

.4 All data generated during the commissioning process, including start-up reports, evaluation checklists and completed test certificates and reports.

.5 Equipment Operating schedules including set points.

.6 List of all incomplete/ deferred testing.

.7 Manufacturer’s recommended calibration and preventive maintenance instructions.

.5 Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CA. Refer to Section 01 91 13 for details.

3.6. TRAINING OF OWNER PERSONNEL

.1 Demonstration and training shall not proceed until the following tasks and deliverables have been completed and reviewed/approved by the CA:

.1 Functional Performance Testing Completed, including Issues Log summarizing status/remaining issues. Systems verified to be operating to design intent.

.2 O&M Manuals have been reviewed, approved, and final version submitted to the owner

.3 Record Drawings completed and submitted to the owner. In the absence of final Record Drawings, a full colour, full size scanned copy of the as-builts may be provided by the contractor in both hard and digital copy.

.2 Detail information regarding contents, duration and instructors for any particular system is included in Section 01 79 00.13: Commissioning –Training.

3.7. DEFERRED AND SEASONAL TESTING

.1 Refer to Section 01 91 13, Part 3.14 for general requirements of deferred testing.

.2 Voltage Checks

.1 Make voltage checks throughout the project after the project has been in operation for 30 days, and at this time, if directed by the Consultant, adjust transformers tap settings. Readings taken shall be logged, tabulated and any adjustments made to building system shall be suitably incorporated in the Operating & Maintenance Manuals.

.3 Power Factor Readings

.1 Division 26 to allow for certified power factor readings in base tender amount. Readings to be taken after the complex is fully occupied and operational for 60 days

.2 Power factor shall be recorded at the following locations:

.1 Main Distribution Centres

.2 Motor Control Centres

.4 The Contractor shall allow for at least 2 separate 4 hour visits to the site for general trouble shooting and overseeing the operation and maintenance of all systems and equipment during the first full year warranty period following the final Commissioning and Substantial Performance Certificate being issued.

.1 These site meetings are over and above normal trouble and warranty call backs.

.2 These site visits shall be coordinated with post-occupancy review performed by the design professionals and Commissioning Authority.

.3 The purpose of these site visits is to investigate and troubleshoot the system operations and any problems and to ensure that all systems and equipment are being properly operated and maintained.

3.8. WRITTEN WORK PRODUCTS

.1 Contractor's written work products will consist of the startup and initial checkout plan and functional testing described in this section and Section 01 91 13 General Commissioning Requirements and the completed startup, initial checkout and pre-functional, and functional checklists.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

.2 Ontario Electrical Safety Code

.3 Ontario Building Code

1.3. SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures and Section 23 05 00 - Common Work Results for HVAC and Section 26 05 00 – Common Work Results for Electrical.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2 PRODUCTS

2.1. PANELBOARDS

.1 Panel board Standard Trims (FAS – Latch)

.2 Type of panel: P2

.3 Voltage of system: L = 208V/120V 3Ø 4 W

.4 Circuits or Enclosure Height: P2 – 42

.5 Main Lug (ML) Main Breaker: MLO

.6 Bus Material/Amps: Copper/125A

.7 Feed location: B=bottom

.8 Mounting: S=surface. Flush trim extend 19mm beyond each side of the base box dimensions on P1, P2 and P3 and extend 25.4mm beyond each side of the base box dimension on.

.9 Main Breaker panel connectors: Ampere ratings 100A, Connector wire range (1) from ♯10 to 4/0 AWG CU

.10 Acceptable manufacturers: Eaton-Cutler Hammer, Schneider and SIEMENS Canada

2.2. BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Consultant.

.5 Lock-on devices for receptacles, fire alarm, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.3. EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

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. Where practical, group panelboards, and other electrical equipment if present, on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No 248 (Latest revision) – Low Voltage fuses

.2 Ontario Electrical Safety Code

.3 Ontario Building Code

1.3. SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures and Section 26 05 00 – Common Work Results for Electrical.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2 PRODUCTS

2.1. FUSES

.1 Fuse type reference L1, L2, J1, R1 etc. have been adopted for use in this specification.

.2 Fuses: Product of one manufacturer shall be provided for this project

.3 Acceptable manufacturers: Bussman, Gould.

2.2. FUSE TYPES

.1 Class L fuses (formerly HRC-L).

.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 (formerly HRCI- J).

.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 -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its' peak let-through values not to exceed limits of UL 198E-1982, table 10.2.

.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 (formerly HRCII- C).

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 finished in accordance with Section 26 05 00 – Common Work Results - Electrical.

3 EXECUTION

3.1. INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit. Ensure correct fuses fitted to physically matched mounting devices.

.1 Install Class R rejection clips for HRCI-R fuses.

.2 Ensure correct fuses fitted to assigned electrical circuit.

.3 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

.4 Install spare fuses in fuse storage cabinet.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.1 CSA International

.1 CSA C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

.2 Ontario Electrical Safety Code

.3 Ontario Building Code

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 23 05 00 - Common Work Results for HVAC and. Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Include time-current characteristic curves for all breakers.

.4 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.2 Production certificate of origin must be submitted to Consultant for approval.

.3 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.4 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Consultant. Unless complying with this requirement, Consultant reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.5 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

1.4. DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 circuit breakers in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect circuit breakers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1. BREAKERS GENERAL

.1 Molded-case circuit breakers: to CSA C22.2 No. 5

.2 Bolt-on molded case circuit breakers.

.3 Molded 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.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as per panel rating practice.

2.2. OPTIONAL FEATURES

.1 Include:

.1 Shunt trip.

3 EXECUTION

3.1. INSTALLATION

.1 Install circuit breakers as indicated on drawings.

3.2. CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical

1.2. REFERENCE STANDARDS (LATEST REVISIONS)

.1 CSA Group

.1 CAN/CSA-C22.2 No.4, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).

.2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00- Submittal Procedures and Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for [disconnect switches - fused and non-fused] and include product characteristics, performance criteria, physical size, finish and limitations.

2 PRODUCTS

2.1. DISCONNECT SWITCHES

.1 Fusible / Non-fusible disconnect switch in CSA enclosure.

.2 Provision for padlocking in off position.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size where indicated, in accordance with Section 26 28 13.01- Fuses - Low Voltage.

.5 Quick-make, quick-break action.

.6 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 for Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

3 EXECUTION

3.1. EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused 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 disconnect switches complete with fuses if applicable.

3.3. CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00- Cleaning.

.1 Leave Work area clean at end of each day.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical

1.2. REFERENCE STANDARDS (LATEST REVISIONS)

.1 Canadian Standards Association (CSA)

.2 National Electrical Manufacturer Association (NEMA)

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures and 26 05 00 Common Work Results for Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00- Submittal Procedures and 26 05 00 Common Work Results for Electrical.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

.2 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.4. CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00- Closeout Submittals.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

.3 Extra Materials:

.1 Provide listed spare parts for each different size and type of starter.

[3] contacts, stationary.

[3] contacts, movable.

[1] contacts, auxiliary.

[1] control transformer[s].

[1] operating coil.

[2] fuses.

[10] % indicating lamp bulbs used.

2 PRODUCTS

2.1. MATERIALS

.1 Provide where indicated on drawings and/or as shown on Motor Schedules motor starters for all mechanical equipment (except those equipped with packaged starters).

.2 Provide starter including but not limited to fused/unfused disconnect switch, ON – OFF push buttons, indicating lamps (Green - Running, Red - Off/Trouble), overload protection fuse, control transformer and control wires etc.

.3 Weatherproof where installed outdoors

.4 Acceptable starters manufacturers are Eaton, Klockner Moeller, SIEMENS Canada, Square-D and Schneider.

.5 Acceptable fuse manufacturers: Electric Company, Chase Shawmut-Amp, Trap, English Electric Company of Canada.

2.2. FULL VOLTAGE MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 Contactor solenoid operated, rapid action type.

.3 Motor overload protective device in each phase, manually reset from outside enclosure.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram

.2 Accessories:

.1 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3. COMBINATION STARTER – DISCONNECT SWITCH TYPE

.1 Product overview:

.1 Disconnect switch type combination starters can be furnished with either a fusible or non-fusible disconnect switch.

.2 Disconnect switch type combination starters are available in NEMA Size 0–6.

.3 The design of the fusible disconnect switch combination starter uses a flange-operated visible blade switch.

.4 Interchangeable fuse clips, straight-through wiring, space for a fused control transformer with additional capacity, and provisions for adding a disconnect switch electrical interlock are key features of the combination starters.

.5 The fusible disconnect switch device can be furnished with Class R fuse clips, increasing the short-circuitrating to 100,000 A.

.6 Size 0–2 non-fusible combination starters can be converted to a fusible type.

.7 Starter shall be included but not limited to overload protection, H/O/A switch and pilot lamps (Green - Running, Red - Stop/Trouble).

.2 Overload protection

.1 Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors.

.2 Motor overload protection for three-phase starter applications can be provided through one of four options, as follows:

.1 Solid-State Overload Relay Protection (Motor Logic™ SSOLR)

.1 These ambient insensitive overload relays are available on Sizes 00–6 and standard on Size 7.

.2 They provide phase loss and phase unbalance protection.

.2 Adapted Bimetallic Overload Relay (NEMA Sizes 00–1)

.1 The adapted bimetallic motor starter consists of a specially designed adapter.

.2 It attaches with bus bars to the Type S NEMA contactor and holds the IEC-style bimetallic overload relay (type LRD or LR3D).

.3 TeSys™ T Motor Management System (NEMA Sizes 1–6)

.1 The flexible TeSys T system integrates seamlessly into your automation system through five major communication protocols.

.2 The TeSys T system can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range.

.3 This option is available for control voltages of 24 Vac or 100–240 Vac.

.4 Melting Alloy Thermal Overload Relays

.1 Melting alloy type thermal overload blocks are installed as part of the starter, and thermal elements must be selected and installed separately in order to operate the starter.

.3 Acceptable Manufacturers:

.1 Schneider Electric, Siemens or Approved Equal

2.4. PRE-CONFIGURED NEMA COMBINATION MOTOR STARTER

.1 Product overview:

.1 With the NEMA 12/3R enclosure, these combination starters are ready for use in most common indoor and outdoor applications.

.2 The Motor Logic electronic overload provides a wide selection range of FLA without the need for additional melting alloys.

.3 These combination starters contain the following features:

.1 Fusible Disconnect(classH/K)or Motor Circuit Protector

.2 Square D Type S Starter with Electronic Overload

.3 Hand-Off-Auto with Green ON, RedOFF/TROUBL LED lights with reset button

.4 Auxiliary contacts

.5 SPDT Aux on disconnect

.6 Benshaw ‘soft starter’ type combination magnetic starters for minimum 10HP.

.2 Fusible disconnect switch:

.1 Voltage (VAC) :480/600

.2 Horsepower : 5-10

.3 NEMA Size: 0 or 1

.4 Fuse Clip Size (A): 30

.5 Overload Range (FLA): 6-18

.3 Acceptable Manufacturers:

.1 Schneider Electric, Siemens or approved equal

2.5. CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 208 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.6. ACCESSORIES

.1 Pushbutton: Standard as required.

.2 Indicating lights: Standard colours.

2.7. FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00- Common Work Results for Electrical.

2.8. EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 4

3 EXECUTION

3.1. INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire, starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2. FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3. CLEANING

.1 Clean in accordance with Section 01 74 00- Cleaning.

END OF SECTION

1 GENERAL

1.1. RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results – Electrical.

1.2. REFERENCES (LATEST REVISIONS)

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

.2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.3 ASTM International Inc.

.1 ASTM F 1137, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 Canadian Standards Association (CSA International)

.5 ICES-005, Radio Frequency Lighting Devices.

.6 Underwriters' Laboratories of Canada (ULC)

.7 provincial Electrical Safety Code

.8 provincial Building Code

1.3. ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures] and Section [23 05 00 - Common Work Results for HVAC] and Section 26 05 00 – Common Work Results for Electrical.

.1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

.2 Shop drawing for each light fixture and associated controls (occupancy sensors, relays, wall pod switches, and occupancy sensor combination switches) as specified shall be provided for approval.

.3 Shop drawings shall identify the number of drivers in each light fixture.

.4 All light fixtures shall be DLC or Energy Star listed.

1.4. WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of all labor, materials, and equipment required for installation, testing and putting into proper operation the complete lighting systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.5. REQUIREMENTS

.1 Light fixtures shall not be delivered to the building or stored therein until dry and protected space is available for proper storage of light fixtures.

.2 Finishes of fixtures shall be as specified in the "Light fixture List" must be maintained. Color of finish shall be confirmed prior to placing of order for fixtures.

1.6. QUALITY ASSURANCE

.1 Provide mock-ups in accordance with Section 01 45 00 - Quality Control.

2 PRODUCTS

2.1. GENERAL

.1 Similar light fixtures shall be products of same manufacturer.

.2 Light fixtures shall be suitable for individual mounting.

.3 Wall mounted linear fixtures to be installed perfectly horizontal

.4 Light fixtures shall be completely assembled in the factory and shall be delivered to building in cartons or in palletized form, as directed.

2.2. BALLASTS AND DRIVERS

.1 LED Drivers:

.1 Operable from 50/60 Hz input source of 120V with sustained variations of ± 10% (voltage) with no damage to the driver.

.2 Input power factor greater than 0.90 from 20% to 100% rated load.

.3 Input current Total Harmonic Distortion (THD) less than 20% from 20% to 100% rated load.

.4 Comply with NEMA 410 for in-rush current limits.

.5 Output current regulated to ± 5% across published load range.

.6 Output ripple current at maximum output:

.1 less than 15% measured peak-average/average,

.2 less than 5% low frequency content (< 120 Hz.).

.7 Integral means of limiting surges to the LED’s, based on IEEE/ANSI C62.41.2 surge characteristics:

.1 for interior applications: common mode and differential mode surge protection of 2.5kV (100kHz, 30 Ohm ring wave),

.2 for exterior applications: common mode and differential mode surge protection of 3kV (1.2/50µs, 2 Ohm combination wave).

.8 Able to tolerate sustained open circuit and short circuit output conditions without failure, without need for external fuses or trip devices. Auto resetting.

.9 No visible flicker when tested with flicker wheel.

.10 For dimming systems: no visible flicker, when tested with flicker wheel, across the full dimming range.

.11 Minimum operating temperature:

.1 -20˚C (-4˚F) for interior applications,

.2 -40˚C (-40˚F) for exterior applications.

.12 Metallic enclosure for optimal thermal performance.

.13 Integral thermal foldback to reduce driver power if case temperature exceeds rated maximum temperature.

.14 Compatible with the dimming system.

.15 Class A sound rating.

.16 Rated for UL Damp and Dry locations.

.17 Integral color-coded connectors.

.18 Free of any Polychlorinated Biphenyls (PCBs).

.19 Labelled compliant with the latest edition of the following standards:

.1 CSA-C22.2 No. 223, Power Supplies with Extra-Low Voltage Class 2 Outputs,

.2 CSA C22.2 No 250-13, Light Emitting Diode (LED) Equipment for use in Lighting Applications.

.20 Comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, for non-consumer equipment.

.21 RoHS compliant.

.22 Warranty: 5 years

.23 Standard of Acceptance

.1 Day-Brite or Approved Equal

2.3. LAMPS

.1 Light Emitting Diodes

.1 1.2 or 3 watts per LED.

.2 Available in 2700K, 3000K, 3500K and 4000K correlated color temperature (CCT) packages. CCT tolerances to remain within a 3-step MacAdam ellipse and to maintain a CRI of ≥80, and an R9 > 50. Light fixture schedule will dictate color temperature/CRI for each light fixture.

.3 Color temperature and lumen output for each light fixture per light fixture schedule. Comply with IESNA LM-79 testing procedures.

.4 Maximum temperature at the base of the “LED cap” mounted to the substrate to be controlled to ensure full lamp life.

.5 Minimum lumen maintenance of L70 @ 50,000 hours. Comply with IESNA LM-80 and LM-21 testing procedures.

.6 LEDs of the same type to be from the same manufacturing batch.

.7 Capable of continuous dimming, flicker and noise free, from 10-100% lumen output.

.8 Provide certified test results for each type of LED used on the project.

.9 Warranty: 5 years

.10 Standard of Acceptance- Lamp Acceptance:

.1 Day-Brite or Approved Equal

2.4. LED PANELS

.1 Refer to the electrical drawings light fixture schedule.

2.5. FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.6. CONTROL DEVICES

.1 Switches

.1 Line Voltage Single Pole Switch

.2 Line Voltage Switch c/w Vacancy Sensor

.3 Line Voltage Three Way Switch

.2 Family Features

.1 Available for 120-277 V line voltage switching (sink- only control) 0-1 O V= LED drivers and ballasts (power pack not required for loads up to 8 A)

.2 Suitable for commercial applications

.3 Multi-gang alignment for quick and easy installation

.4 Full family of products for most lighting sources, plus matching accessories and wall plates

.5 Rated at 120 V at 60 Hz, unless noted otherwise

.3 Regulatory Approvals

.1 UL» Listed

.2 CSA

.3 NOM

2.7. LUMINAIRES

.1 As indicated on drawings.

3 EXECUTION

3.1. INSTALLATION

.1 Locate and install light fixtures as indicated. Fixtures are to be connected to existing normal or emergency circuits as existing.

.2 Verify the quantity of light fixtures before placing orders.

.3 Verify ceiling types on site and order light fixtures to suit the correct ceiling.

.4 Check lighting light fixtures and mountings for their electrical and physical characteristics. Make necessary adjustments to light fixtures or hanging arrangement without expense to Owner. Give notification at the time of shop drawings and before construction if a decision requiring changes is required.

.5 Co-operate with other trades to ensure proper installation of lighting light fixtures.

.6 Carefully align light fixtures, shown in continuous lines or rows, so that rows appear as straight lines.

.7 Mount light fixtures perfectly level or plumb. Light fixtures shall fit tightly to the ceiling without showing a space or light leak between frame and ceiling.

.8 Take down any improperly installed light fixtures and re-install without expense to Owner.

.9 Obtain approval before any changes are made to layouts shown.

.10 All light fixtures mounted on ceilings shall be mounted directly to conduit outlet box and adequately grounded.

.11 Provide continuous 12mm x 38mm (½" x 1½") channel above the ceiling, where light fixtures are suspended or mounted on furred ceilings. Fasten light fixtures to channel with two 6mm (¼") minimum diameter studs with minimum 1220mm (4'-0") on centre.

3.2. WIRING

.1 Connect luminaires to lighting circuits:

.1 Install flexible or rigid conduit for luminaires as indicated.

3.3. LUMINAIRE SUPPORTS

.1 For suspended ceiling installations [support luminaires independently of ceiling at diagonal corners minimum and comply with manufacturer's requirement, for seismic protection.

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. CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION