PROJECT MANUAL

Issued for Bid

William G. Davis Building Renovation
UTM 2017-18-61 DV ERS/GGR/HCC Reno Phase 3 Lab

University of Toronto Mississauga
1867 Inner Circle, Mississauga, Ontario

Architecture Counsel
75 Berkley Street
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Project No. 22121

April 21, 2023

1.1 Document Responsibility

.1 Refer to Project Manual, Section 00 01 10 - Table of Contents, for indication of document responsibility (DR). Abbreviations for entity responsible for document preparation are as follows:

.1 A - Denotes documents prepared by Architect.

.2 D - Denotes documents prepared by Designated Substances Consultant.

.3 E - Denotes documents prepared by Electrical Engineer.

.4 H - Denotes documents prepared by Architectural Hardware Consultant.

.5 M - Denotes documents prepared by Mechanical Engineer.

.6 O - Denotes documents prepared by Owner.

.7 S - Denotes documents prepared by Structural Engineer.

.2 Professional seals if applied next to company names in the project directory (below) govern only those specification sections and schedules identified by the corresponding document responsibility (DR) abbreviation in Section 00 01 10.

1.2 Project Directory

.1 Owner:

University of Toronto Mississauga
Facilities Management & Planning
3359 Mississauga Road North
Mississauga, Ontario
L5L 1C6

.2 Architect (the *Consultant*):

Architecture Counsel Inc.
75 Berkeley Street
Toronto, Ontario
M5A 2W5

Tel: 416-603-1515

.3 Structural Engineer:

Read Jones Christoffersen
100 University Avenue, Suite 300
Toronto, Ontario
M5H 4H2

Tel: 416-977-5335

.4 Mechanical Engineer:

Quasar Consulting Group
250 Rowntree Dairy Road
Woodbridge, Ontario
L4L 9J7

Tel: 905-507-0800

.5 Electrical Engineer:

Quasar Consulting Group
250 Rowntree Dairy Road
Woodbridge, Ontario
L4L 9J7

Tel: 905-507-0800

.6 Architectural Hardware Consultant:

Upper Canada Speciality Hardware
7100 Warden Avenue, Unit #1
Markham, Ontario
L3R 8B5

Tel: 905-940-8358

.7 Designated Substance Consultant:

SafeTech Environmental Ltd.
3045 Southcreek Rd Unit 14
Mississauga, Ontario
L4X 2X7

Tel: 905-624-2722

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END OF SECTION

1.1 Information Available for Review

.1 The following documents are made available for review:

.1 Hazardous materials/designated substances report:

.1 “Designated Substances and Hazardous Materials Assessment, Renovation Project 2017-18-17 DV ERS/GGR/HCC Phase 2 and Phase 3, University of Toronto Mississauga”, dated November 26, 2019, prepared by SafeTech Environmental Ltd.

.2 The accuracy of the information contained in the above listed documents has not been independently verified by the *Consultant*.

END OF SECTION

1.1 WORK OF THIS CONTRACT

.1 *Work* of this *Contract* comprises the following:

DV ERS/GGR/HCC Reno
UTM PROJECT NUMBER: 2017-18-61

.1 Municipal Address: UNIVERSITY OF TORONTO MISSISSAUGA
DV ERS/GGR/HCC RENO PHASE 3 LAB
WILLIAM G DAVIS BUILDING,
1867 INNER CIRCLE ROAD, MISSISSAUGA ON L5L 1C6

1.2 DIVISION OF WORK

.1 Division of the *Work* among *Subcontractors* and *Suppliers* is solely *Contractor*'s responsibility. *Consultant* and *Owner* assume no responsibility to act as an arbiter to establish subcontract limits between Sections or Divisions of the *Work*.

1.3 SPECIFICATIONS LANGUAGE AND STYLE

.1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to *Contractor*, unless stated otherwise.

.2 Complete sentences by reading "shall", " *Contractor* shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.

.3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.

.4 When used in the context of a *Product*, read the word “provide” to mean “supply and install to result in a complete installation ready for its intended use”.

1.4 CONTRACT DOCUMENTS FOR CONTRUCTION PURPOSES

.1 *Owner* will supply *Contractor* with a complete set of *Contract Documents* in electronic form before commencement of the *Work*. *Contractor* may print hard copies for construction purposes as required.

.2 Owner will supply Contractor with a complete set of approved building permit documents in electronic form before commencement of the Work. Contractor will print hard copies and keep a set at the site at all time until the building permit is closed.This should include Permits, drawings and documents associated with permits, inspection certificates, and other documents required by authorities having jurisdiction

1.5 DOCUMENTS AT THE SITE

.1 Keep the following documents at *Place of the Work*, stored securely and in good order and available to *Owner* and *Consultant* in hard copy and electronic form:

.1 Current *Contract Documents*, including *Drawings*, *Specifications* and addenda.

.2 *Change Orders*, *Change Directives*, and *Supplementary Instructions*.

.3 Reviewed *Shop Drawings*, *Product* data and samples.

.4 Field test reports and records.

.5 Construction progress schedule.

.6 Meeting minutes.

.7 Manufacturer’s certifications.

.8 Permits, inspection certificates, and other documents required by authorities having jurisdiction.

.9 Current as-built drawings.

.10 Material Safety Data Sheets (MSDS) for all controlled *Products*.

.11 Contractor and Sub-Contractors COVID-19 Acknowledgement Form and daily contact tracing log

1.6 CONTRACTOR'S USE OF PREMISES

.1 Refer to Section 00 14 00 – Work Restrictions.

.2 Confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and *Contract Documents*, whichever is most restrictive. Do not unreasonably encumber *Place of the Work*.

.3 Contractor must use the UTM construction key/cylinder. Construction access keys will be provided by project PM to be signed out by the Contractor and returned at the end of the project.

1.7 OWNER-SUPPLIED PRODUCTS

.1 *Owner* Responsibilities:

.1 Order and pay for *Owner*-supplied *Products* not already in *Owner*'s possession.

.2 Arrange and pay for delivery of *Owner*-supplied *Products* F.O.B. the site, within time frames required by *Contractor*'s progress schedule. If delivered sooner than required by *Contractor*'s latest progress schedule submitted to *Owner*, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.

.3 Advise *Contractor* in writing of the value of *Owner*-supplied *Products* for *Contractor*'s insurance purposes.

.4 Arrange and pay for delivery to *Contractor* of reviewed *Shop Drawings*, *Product* data, samples, and manufacturer's installation instructions, and].

.5 Inspect deliveries jointly with *Contractor*.

.6 Submit claims for transportation damage.

.7 Arrange for replacement of damaged, defective or missing items identified at time of delivery.

.8 Arrange for manufacturer's field services.

.9 Arrange for delivery of manufacturer's warranties to *Contractor* for inclusion in operation and maintenance manual.

.2 *Contractor* Responsibilities:

.1 Designate in progress schedule, time frames for delivery of *Owner*-supplied *Products* to the site and for receipt of related submittals. If the site is not ready to receive delivery of *Owner*-supplied *Products* within the time frame indicated in the latest progress schedule submitted to *Owner*, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.

.2 Review all required submittals and notify *Consultant* of any observed discrepancies or anticipated problems.

.3 Ensure that course of construction insurance is adequate to cover *Owner*-supplied *Products*.

.4 Receive and unload *Owner*-supplied *Products* at the site.

.5 Inspect deliveries jointly with *Owner*. Record and notify *Owner* and *Consultant* of shortages and visibly damaged or defective items.

.6 Handle *Owner*-supplied *Products* at site, including uncrating and storage. Dispose of waste materials and debris.

.7 Take appropriate precautions to protect *Owner*-supplied *Products* from loss or damage.

.8 Repair or replace items damaged on site.

.9 Assemble, install, connect, adjust, and finish *Owner*-supplied *Products* as specified.

.10 Arrange for inspections required by authorities having jurisdiction as specified.

.11 Arrange for or perform testing as specified.

.12 Workmanship warranty for installation.

.3 Schedule of *Owner*-supplied *Products*:

.1 As indicated on Drawings.

END OF SECTION

1.1 RESTRICTIONS ON USE OF PREMISES

.1 Limit use of premises for *Work*, to allow;

.1 *Owner* access.
.2 Work by other contractors.
.3 Public usage in corridors and common public spaces in the building.

.2 Coordinate use of premises under direction of *Owner*.

1.2 WORK SEQUENCE

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

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

1.3 OWNER OCCUPANCY

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

.2 *Owner* will occupy designated areas for purpose of storage of furnishings and equipment.

1.4 RESTRICTED HOURS OF WORK IN OCCUPIED FACILITIES

.1 Work may not be performed between 8:00 p.m and 8:00 a.m. Coordinate after hour work with Owner prior to scheduling the work

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

1.5 NOISY WORK RESTRICTIONS IN OCCUPIED FACILITIES

.1 Schedule excessively noisy work to avoid disturbance to building occupants. Perform excessive noise generating work outside of *Owner*'s business hours which are Monday to Friday from 8:00 a.m. to 8:00 p.m.

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

.3 Provide Owner with minimum 7 business days' and/or 14 days', if fire watch is required, written notice of any construction activities that cause excessive noise or vibration. Reschedule such construction activities if they interfere with sensitive university procedures.

.4 W G Davis Building will be occupied during the course of construction. No noisy work shall be permitted during the exam period 9:00am to 5:00pm, to be coordinated with UTM PM.

.5 Work which results in significant noise, audible to areas outside the Work Area, or which transmits vibratory sounds through the building assemblies, or is being performed by an Asbestos Abatement Subcontractor, or involves Asbestos work procedures, shall be performed between 8:00PM to 8:00AM after regular working hours from Monday to Friday, and/or on weekends.

.6 Disruptive and noisy work should be carefully orchestrated and any disruptions to be kept to a minimum and carefully synchronized so it does not disrupt student and staff community.

.7 Examples of work which transmit vibratory sounds through building assemblies include but not limited to: hammer-drilling, core-drilling, powder-activated concrete nails, demolition, saw cutting, chipping or hammering of concrete floors and masonry or concrete walls dropping objects on floors, drywall framing and installation etc.

1.6 DUST, NOISE AND VIBRATION CONTROLS- GENERAL

.1 At the start up meeting, confirm with the Owner (University) which adjacent areas/ floors are most sensitive and

concerned to construction dust, noise and vibration.

.2 Take measures to control dust, noise and vibration generated by the Work.

.3 Take appropriate dust, noise and vibration control measures at times found necessary and at other times when complaints of dust, noise and vibration are received from the Public, the authorities having jurisdiction, the Owner (University) and Consultant.

.4 The dust, noise and vibration control requirements are for the consideration of the Public and the authorities having jurisdiction. These dust, noise and vibration control requirements shall not be construed as cause for elimination or restriction of the Contractor's construction schedule, claims for delay of the Work, or additional costs for the Work.

.5 Contractor shall be required at all times to keep to a minimum all noise of construction personnel, machines, tools, trucks and the like.

.6 All equipment and tools shall be selected on a minimum noise basis.

.7 Electric rather than gasoline type compressors shall be used in the Work of this Contract.

.8 Scheduling of unavoidably noisy parts of the Work likely to disturb the students, education staff and/or the University personnel/staff shall be during restricted hours, arranged in advance with the University Project Manager and Consultant. Construction with excessive noise in the Owner's (University's) opinion may be limited afterhours 8PM-8AM.

.9 The Contract Price shall include for these requirements. Failure to take this requirement into consideration shall result in claims for extra being rejected, and without any cost to the Owner (University).

1.7 MAINTAINING LIFE SAFETY SYSTEMS IN OCCUPIED FACILITIES

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

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

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

1.8 BASE BUILDING SERVICE INTERRUPTION

.1 The existing William G. Davis Building will be occupied during the course of construction. Special work constraints will apply including but not limited to; rigorous dust control, disruptive work, noisy work, temporary measures, and special work timings for any and all system shut downs.

.2 Base building service interruptions including Plumbing, HVAC, Control Systems, Gas, Vacuum, Emergency power, normal power, lighting, and other base building service interruptions including FA verifications will be done afterhours and as such, bids should reflect this.

.3 2 weeks notification should be provided to the UTM Project manager via Base Building Service Interruption Form to notify the stakeholders and student community about these interruptions. Contractor to assist in investigating the areas that will be affected by these interruptions.

.4 FA Bypass request should be presented to UTM Project Manager in a weekly manner for approval by the Utilities department. . BBSIR should be presented a week prior to the upcoming week.

1.9 SITE ACCESS, DELIVERIES, MATERIAL DISPOSAL, WORK COORDINATION- GENERAL

.1 The project is located in W G Davis building which has a loading dock in level 0, accessed from outer ring road. There is also a freight elevator from level 0 to level 3.

.2 However, due to various constructions and regular maintenance these facilities might not be available at all times. Contractor to take into account the following circumstances while pricing for this project as this project involves excavation, disposing off materials, delivery of materials & machinery required for construction on site

- Reduced access at Loading dock including occasional non-availability of loading bays
- Potential limitation of Freight elevator
- Coordination with other ongoing projects for usage of service rooms, loading docks and common areas
- Limitation for providing space for locating contractors garbage bins near the project location

.3 In case the passenger elevators are used, it should be protected by wall pads and can only be used after hours with prior notification.

END OF SECTION

1.1 DEFINITION

.1 In this Section "Substitution" means a *Product*, a manufacturer, or both, not originally specified in *Contract Documents* by proprietary name but proposed for use by *Contractor* in place of a *Product*, a manufacturer, or both, specified by proprietary name.

1.2 SUBSTITUTION PROCEDURES

.1 *Contractor* may propose a Substitution wherever a *Product* or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.

.2 *Contractor* may propose a Substitution wherever a *Product* or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without *Consultant*'s prior acceptance in writing. Do not order or install any Substitution without a *Supplemental Instruction* or *Change Order*.

.3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements For Proposed Substitutions, *Consultant* will promptly review and accept or reject the proposed Substitution.

.4 *Consultant* may accept a Substitution if satisfied that:

.1 the proposed substitute *Product* is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,

.2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and

.3 the Substitution provides a benefit to *Owner*.

.5 If *Contractor* fails to order a specified *Product* or order a *Product* by a specified manufacturer in adequate time to meet *Contractor*'s construction schedule, *Consultant* will not consider that a valid reason to accept a Substitution.

.6 If *Consultant* accepts a Substitution and subject to *Owner*'s agreement, the change in the *Work* will be documented in the form of either a *Supplemental Instruction* or *Change Order* as specified in Section 01 26 00 – Contract Modification Procedures.

.7 If a Substitution is accepted in the form of a *Supplemental Instruction* or *Change Order*, *Contractor* shall not revert to an originally specified *Product* or manufacturer without *Consultant*'s prior written acceptance.

1.3 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

.1 Include with each proposed Substitution the following information:

.1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.

.2 Reason(s) for proposing the Substitution.

.3 A statement verifying that the Substitution will not affect the *Contract Price* and *Contract Time* or, if applicable, the amount and extent of a proposed increase or decrease in *Contract Price* and *Contract Time* on account of the Substitution.

.4 A statement verifying that the Substitution will not affect the performance [or warranty] of other parts of the *Work*.

.5 Manufacturer's *Product* literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.

.6 Product samples as applicable.

.7 A summarized comparison of the physical properties and performance characteristics of the specified *Product* and the Substitution, with any significant variations clearly highlighted.

.8 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.

.9 If applicable, estimated life cycle cost savings resulting from the Substitution.

.10 Details of other projects and applications where the Substitution has been used.

.11 Identification of any consequential changes in the *Work* to accommodate the Substitution and any consequential effects on the performance of the *Work* as a whole. A later claim for an increase to the *Contract Price* or *Contract Time* for other changes in the *Work* attributable to the Substitution will not be considered.

END OF SECTION

1.1 SCHEDULE OF LABOUR RATES

.1 Prior to the first application for payment, submit for the Consultant's review a schedule of labour rates for all trades and classifications of trades, such as journeymen, apprentices, and foremen that will be employed in the Work. Provide a breakdown of payroll burden component of labour rates.

.2 Labour rates shall reflect the salaries, wages, and benefits paid to personnel in the direct employ of the Contractor, Subcontractors, and sub-Subcontractors, stated as hourly rates, that will be used when:

.1 preparing price quotations for Change Orders, and

.2 determining the cost of work attributable to Change Directives.

.3 Labour rates stated in the schedule of labour rates shall be consistent with rates that will actually be paid, and payroll burden costs that will actually be incurred, in the normal performance of the Work, during regular working hours. Labour rates shall not include any additional overhead and profit component.

.4 Where collective agreements apply, the labour rates shall not exceed those established by collective agreement.

.5 Obtain the Owner's written acceptance of the schedule of labour rates before submitting the first Change Order quotation.

.6 Accepted schedule of labour rates will be used solely for evaluating Change Order quotations and cost of performing work attributable to Change Directives.

.7 The Contractor may request amendments to the accepted schedule of labour rates if changes in the labour rates that will actually be paid, or payroll burden cost that will actually be incurred, in the normal performance of the Work can be demonstrated. Obtain the Owner's written acceptance of such changes.

1.2 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE ORDERS

.1 Unless otherwise agreed, the adjustment of the Contract Price on account of a proposed change in the Work shall be based on a quotation for a fixed price increase or decrease to the Contract Price regardless of the Contractor's actual expenditures and savings.

1.3 CHANGE ORDER PROCEDURES

.1 Upon issuance by the Consultant to the Contractor of a proposed change in the Work, and unless otherwise requested in the proposed change or unless otherwise agreed:

.1 Submit to the Consultant a fixed price quotation for the proposed change in the Work within 5 days after receipt of the proposed change in the Work.

.2 If requested in the proposed change, provide a detailed breakdown of the price quotation including the following to the extent applicable, with appropriate supporting documentation:

.1 Estimated labour costs, including hours and applicable hourly rates based on the accepted schedule of labour rates.
.2 Estimated Product costs, including Supplier quotations, estimated quantities and unit prices.
.3 Estimated Construction Equipment costs.
.4 Enumeration of all other estimated costs included in the price quotation.
.5 Estimated credit amounts for labour and Products not required on account of the proposed change.
.6 Fees, not exceeding the applicable percentages for overhead and profit as specified in this Section.
.7 Where applicable, Subcontractor quotations, also including a detailed breakdown of all of the above.

.3 Include in the quotation the increase or decrease to the Contract Time, if any, for the proposed change, stated in number of days.

.4 Include in the quotation the number of days for which the quotation is valid.

.5 The quotation will be evaluated by the Consultant and the Owner and, if accepted by the Owner, be documented in the form of a signed Change Order.

1.4 FEES FOR OVERHEAD AND PROFIT – CHANGE ORDERS

.1 Where the Contractor's price quotation for a Change Order results in a net increase to the Contract Price, the Contractor's entitlement to a fee for overhead and profit in the quotation shall be shall be as indicated in the Supplementary Conditions.

.2 Where the Contractor's or a Subcontractor's price quotation for a Change Order results in a net decrease in price before adjustment for fees for overhead and profit, such a price quotation shall be for the net decrease without any adjustment for fees for overhead and profit.

1.5 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE DIRECTIVES

.1 Unless the Owner and the Contractor reach an earlier agreement on the adjustment to the Contract Price by means of a Change Order that cancels the Change Directive, the adjustment in the Contract Price for change carried out by way of a Change Directive shall be determined as specified in the General Conditions of Contract after the change in the Work is completed.

1.6 CHANGE DIRECTIVE PROCEDURES

.1 If a Change Directive is issued for a change in the Work for which a proposed change was previously issued, but no Change Order has yet been signed, the Change Directive shall cancel the proposed change and any Contractor quotations related to that change in the Work.

.2 When proceeding with a change in the Work under a Change Directive, keep accurate records of daily time sheets for labour and Construction Equipment, and invoices for Product and Construction Equipment costs. Submit such records to the Consultant weekly, until the Change Order superseding the Change Directive is issued.

1.7 FEES FOR OVERHEAD AND PROFIT – CHANGE DIRECTIVES

.1 The Contractor's entitlement to a fee for overhead and profit on the Contractor's expenditures and savings attributable to a Change Directive shall be as indicated in the Supplementary Conditions.

.4 Where a Change Directive results in net savings on account of work not required to be performed and a net decrease in the Contractor's or Subcontractor's cost, the net savings to the Contractor or Subcontractor shall be calculated without any adjustment for fees for overhead and profit.

.5 When a Change Directive is ultimately recorded as a Change Order, there shall be no additional entitlement to fees for overhead and profit beyond those specified in this article.

1.8 SUPPLEMENTAL INSTRUCTIONS

.1 The Consultant may issue Supplemental Instructions to provide clarifications to the Contract Documents, provide additional information, or make minor variations in the Work not involving adjustment in the Contract Price or Contract Time.

.2 If the Contractor considers a Supplemental Instruction to require an adjustment in Contract Price or Contract Time, the Contractor shall promptly notify the Consultant and the Owner in writing and shall not proceed with any work related to the Supplemental Instruction pending receipt of a Change Order, a Change Directive, or, in accordance with the dispute resolution provisions of the General Conditions of Contract, a Notice in Writing of a dispute and instructions to proceed.

END OF SECTION

1.1 SCHEDULE OF VALUES

.1 Prior to the first application for payment, submit for *Consultant*'s review an initial schedule of values. Modify the initial schedule of values if and as requested by *Consultant*. Obtain *Consultant*'s written acceptance of the initial schedule of values prior to the first application for payment.

.2 Together with the first and all subsequent applications for payment, submit updated versions of the schedule of values to indicate the values, to the date of application for payment, of work performed and *Products* delivered to *Place of the Work*.

.3 Provide the schedule of values in an electronic spreadsheet format that provides for inclusion of the following information:

.1 Identifying information including title and location of the *Work*, name of *Contractor*, number and date of application for payment, and period covered by the application for payment.

.2 A work breakdown structure based on *Specification* sections breakdown. Include separate line items for closeout procedures including closeout submittals, demonstration and training, start-up and testing, and commissioning collectively valued at minimum 2.5% of *Contract Price*.

.3 Provisions for approved *Change Orders* so that the breakdown amounts indicated in the schedule of values aggregate to the current total *Contract Price*. Also provide for indicating the estimated value of *Change Directives* within the schedule of values, separately from the current total *Contract Price*.

.3 For each item in the work breakdown structure, provide as a minimum the following information, under headings as indicated:

.1 Breakdown Amount: A dollar amount, including an appropriate pro rata portion of *Contactor*'s overhead and profit.

.2 Performed to Date: The value of *Work* performed and *Products* delivered to *Place of the Work* up to the date of the application for payment, stated as a percentage of the *Contract Price* and in dollars.

.3 Previously Performed: The value of *Work* performed and *Products* delivered to the *Place of the Work* for which payment has been previously certified, stated in dollars.

.4 Current Period: The value of *Work* performed and *Products* delivered to *Place of the Work* for which *Contractor* is currently applying for payment, stated in dollars.

.5 Balance to Complete: The value of *Work* not yet performed and *Products* not yet delivered to *Place of the Work*, stated in dollars.

1.2 WORKERS' COMPENSATION CLEARANCE

.1 Submit proof of workers' compensation clearance with each application for payment.

1.3 STATUTORY DECLARATIONS

.1 Submit a statutory declaration in the form of CCDC 9A – Statutory Declaration of Progress Payment Distribution by *Contractor* with each application for payment except the first.

1.4 PAYMENT FOR PRODUCTS STORED OFF SITE

.1 *Owner* may, due to extraordinary circumstances and at *Owner*'s sole discretion, make payments for *Products* delivered to and stored at a location other than *Place of the Work*, subjectto:

.1 a request submitted by *Contractor* in writing, with appropriate justification, and

.2 whatever conditions *Owner* or *Consultant* may establish for such payments, as required to protect *Owner*'s interests.

1.5 RELEASE OF HOLDBACK

.1 Conform to the Construction Act. R.S.O. 1990, c. C.30.

END OF SECTION

1.1 CONSTRUCTION START-UP MEETING

.1 Promptly after *Contract* award, the *Consultant* will establish the time and location of a construction start-up meeting to review and discuss administrative procedures and responsibilities.

.2 Senior representatives of *Owner*, *Consultant*, subconsultants, and *Contractor*, including *Contractor*'s project manager and site superintendent, shall be in attendance.

.3 Meeting will be held in person or virtually at the discretion of the *Owner*.

.4 *Consultant* representative will chair the meeting and record and distribute the minutes.

.5 Agenda will include following, as a minimum:
- .1 Appointment of official representatives of *Owner*, *Contractor*, *Subcontractors*, *Consultant*, and subconsultants.
- .2 *Project* communications.
- .3 *Contract Documents* for construction purposes.
- .4 Documents at the site.
- .5 *Contractor*'s use of premises, including office, keys, work areas, storage areas, Owner's requirements (e.g., storage delivery, path of construction activities, by vehicle, by foot, carts, exterior and interior, elevator use, washrooms, bin location);
- .6 *Owner*-supplied *Products*.
- .7 Work restrictions.
- .8 Substitution procedures.
- .9 *Contract* modification procedures.
- .10 Payment procedures.
- .11 Construction progress meetings.
- .12 Construction progress schedule, including long lead time items.
- .13 Submittals schedule and procedures.
- .14 Special procedures.
- .15 Quality requirements, including testing and inspection procedures.
- .16 Contractor's mobilization.
- .17 Temporary utilities.
- .18 Existing utility services.
- .19 Construction facilities.
- .20 Temporary barriers and enclosures.
- .21 Temporary controls.
- .22 Field engineering and layout of work.
- .23 Site safety.
- .24 Site security.
- .25 Cleaning and waste management.
- .26 Closeout procedures and submittals.
- .27 Other items.

1.2 CONSTRUCTION PROGRESS MEETINGS

.1 Schedule regular bi-weekly construction progress meetings for the duration of the *Work*. *Contractor* shall prepare meeting agendas, chair the meetings, and record and distribute the minutes.

.2 Arrange for and provide physical space for meetings. Where meetings are to be held virtually, provide meeting invitation to Zoom or Microsoft Teams.

.3 *Contractor* shall record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.

.4 *Contractor* shall distribute copies of minutes within three Working Days after each meeting to meeting attendees and any affected parties who may not be in attendance.

.5 Ensure that *Subcontractors* attend as and when appropriate to the progress of the *Work*.

.6 Agenda for each meeting shall include the following, as a minimum:
- .1 Work progress since previous meeting.
- .2 Field observations, including any problems, difficulties, or concerns.
- .3 Construction progress schedule.
- .4 Submittals schedule.
- .5 Proposed changes in the *Work*.
- .6 Requests for information.
- .7 Site safety issues.
- .8 Other business.

END OF SECTION

PART 1 - GENERAL

1.1 Administrative

.1 Schedule and administer meetings in accordance with Section 01 31 20 as supplemented herein.

1.2 Pre-Installation Meetings

.1 During the course of the *Work* prior to *Substantial Performance of the Work*, schedule pre-installation meetings as required by the *Contract Documents* and coordinated with the *Consultant*.

.2 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.

.3 Agenda to include the following:

.1 Appointment of official representatives of participants in the *Project*.

.2 Review of existing conditions and affected work, and testing thereof as required.

.3 Review of installation procedures and requirements.

.4 Review of environmental and site condition requirements.

.5 Schedule of the applicable portions of the *Work*.

.6 Schedule of submission of samples, colour chips, and items for *Owner's* consideration.

.7 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.

.8 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to *Consultant* for review of the *Work*.

.9 Requirements for inspections and tests, as applicable.

.10 Delivery schedule of specified equipment.

.11 Special safety requirements and procedures.

.4 The following shall be in attendance:

.1 *Contractor*.

.2 *Subcontractors* affected by the work for which the pre-installation meeting is being conducted.

.3 *Consultant*.

.4 Manufacturer's representatives.

.5 Independent inspection and testing company, as applicable.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

1.1 SUMMARY

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

.2 The purpose of submitting progress schedules is to:

.1 inform *Owner* and *Consultant* of actual progress versus planned progress, and

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

1.2 CONSTRUCTION PROGRESS SCHEDULE

.1 Format and Content:

.1 Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using appropriate scheduling software.

.2 Provide a work breakdown structure identifying key activities, work packages, and major milestones, including long delivery *Products*, inspection and testing activities, preparation and review of mock-ups, shutdown or closure activities, delivery of *Owner* supplied Products, *Owner* performed work, demonstration and training activities, and similar items, at a sufficient level of detail to effectively manage construction progress
.

.3 Provide a 3 week look ahead schedule indicating sound levels – form to be provided by Owner.

.4 Indicate milestone dates for *Ready-for-Takeover* and *Substantial Performance of the Work*.

.2 Submission:

.1 Submit initial schedule to *Owner* and *Consultant* within 10 *Working Days* after *Contract* award.

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

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

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

.5 Submit updated progress schedule bi-weekly to O*wner* and *Consultant*, indicating actual and projected start and finish dates with report date line and progress, activity relationships, critical path, float, and baseline comparison to current progress.

.6 Submit updated 3 week look ahead schedule to Owner, indicating projected start and finish dates with sound levels indicated

1.3 SCHEDULE MANAGEMENT

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

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

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

1.4 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

.1 Obtain a hard copy set of construction *Drawings* for the purpose of creating as-built drawings. Record information and maintain as-built drawings in clean, dry and legible condition.

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

.3 Record actual construction including:

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by *Change Orders* and *Supplemental Instructions*

.6 References to *Shop Drawings*, where *Shop Drawings* show more detail.

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

.5 Submit As-Built drawings in CAD and PDF formats for all disciplines

1.5 PROGRESS PHOTOGRAPHS

.1 Arrange for bi-weekly digital photography to document and provide a photographic record of the progress of the *Work*.

.2 Identify each photograph by project name and date taken.

.3 Submission: Submit .jpg format files in standard resolution via e-mail monthly and framing and services before concealment.

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

END OF SECTION

1.1 ADMINISTRATIVE

.1 Submit specified submittals to *Consultant* for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the *Work*. Failure to submit in ample time is not considered sufficient reason for an extension of *Contract Time* or for *Product* substitutions or other deviations from the *Drawings* and *Specifications*.

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

.3 Do not proceed with *Work* affected by a submittal until review is complete.

.4 Present *Shop Drawings*, *Product* data, and samples in SI metric units. Where items or information is not produced in SI Metric units, converted values are acceptable.

.5 Review submittals, provide verified field measurements where applicable, and affix *Contractor*'s review stamp prior to submission to *Consultant*. *Contractor*'s review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the *Work* and *Contract Documents*.

.6 Verify field measurements and that affected adjacent work is coordinated.

.7 Submittals not meeting specified requirements will be returned with comments.

.8 Reproduction of construction *Drawings* to serve as background for *Shop Drawings* is permitted. If construction *Drawings* are used for this purpose, remove references to *Consultant*.

.9 Do not propose Substitutions or deviations from *Contract Documents* via *Shop Drawing*, *Product* data and sample submittals.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate *Products*, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the *Work*.

.2 Where *Products* attach or connect to other *Products*, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to *Drawings, Specifications* and other already reviewed *Shop Drawings*.

.3 Accompany submittals with a transmittal information including:

- .1 Date.
- .2 *Project* title and number.
- .3 *Contractor*'s name and address.
- .4 Identification of each submittal item and quantity.
- .5 Other pertinent data.

.4 *Shop Drawing* submittals shall include:

- .1 Date and revision dates.
- .2 *Project* title and number.
- .3 Name and address of:
  - .1 *Subcontractor*.
  - .2 *Supplier*.
  - .3 Manufacturer.

.4 *Contractor*'s stamp, date, and signature of *Contractor*'s authorized representative responsible for *Shop Drawing* review, indicating that each *Shop Drawing* has been reviewed for compliance with *Contract Documents* and, where applicable, that field measurements have been verified.

.5 Details of appropriate portions of the *Work* as applicable:

.1 Fabrication.
.2 Layout, showing dimensions, including identified field dimensions, and clearances.
.3 Setting or erection details.
.4 Capacities.
.5 Performance characteristics.
.6 Standards.
.7 Operating weight.
.8 Wiring diagrams.
.9 Single line and schematic diagrams.
.10 Relationships to other parts of the *Work*.

.5 *Product* data submittals shall include material safety data sheets (MSDS) for all controlled Products.

.6 Submit electronic copy in pdf format of *Shop Drawings* where specified in the technical *Specifications*.

.7 Submit electronic copy in pdf format of Product data sheets or brochures where specified in the technical *Specifications*.

.8 Where a submittal includes information not applicable to the *Work,* clearly identify applicable information and strike out non-applicable information.

.9 Supplement standard information to include details applicable to *Project*.

.10 Allow 5 *Working Days* for *Consultant*'s review of each submittal Allow additional 3 *Working Days* where sub-*Consultant* review is required.

.11 If upon *Consultant*'s review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of *Work* may proceed.

.12 If upon *Consultant*'s review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.

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

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

1.3 SAMPLES

.1 Submit samples for *Consultant*'s review in duplicate where specified in the technical *Specifications*. Label samples as to origin, *Project* name, and intended use.

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

.3 Notify *Consultant* in writing of any deviations in samples from requirements of *Contract Documents*.

.4 Where a required colour, pattern or texture has not been specified, submit full range of available *Products* meeting other specified requirements.

.5 *Consultant* selection from samples is not intended to change the *Contract Price* or *Contract Time*. If a selection would affect the *Contract Price* or *Contract Time*, notify *Consultant* in writing prior to proceeding with the *Work*.

.6 Resubmit samples as required by *Consultant* to comply with *Contract Documents*.

.7 Reviewed and accepted samples will establish the standard against which installed *Work* will be reviewed.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 The *Contractor* shall assign a firestopping and smoke seal firestopping coordinator to coordinate the firestopping details and systems required in the *Work*. Applicator shall designate a single individual as *Project* foreperson who shall be present at the *Place of the Work* throughout the *Work*.

1.2 Firestopping manual

.1 *Contractor* and firestopping and smoke seal coordinator shall prepare a preliminary fire stopping manual, inclusive of all firestopping systems in the *Work*, to be submitted to the *Consultant* prior to the installation of any firestopping and smoke seal work.

.2 Manual shall include:

.1 Project key plans of each level, with enlarged key plans at areas where required, which identify and tag each anticipated penetration and fire stopping location and type (i.e. multiple metallic pipes though gypsum board wall assembly; single metallic pipe though concrete floor assembly, and the like)

.2 *Product* data sheets: data and installation instructions for *Products* providing descriptions sufficient for identification at the *Place of the Work*.

.1 Materials list of *Products* proposed for use in the *Work*; complying with listed systems designs.

.2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.

.3 Manufacturers’ installation instructions and recommendations.

.3 Shop drawings:

.1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.

.2 Designate on shop drawings static through penetrations and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.

.3 Engineered shop drawings; for engineering judgements:

.1 Where *Project* conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each Project location and condition.

.2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both *Project* name, *Project* location, and *Subcontractor*'s name who will install firestop system as described in engineering judgement shop drawings.

.3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.

.4 For perimeter fire barrier systems:

.1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.

.4 Fire resistance rating test listings for firestopping and smoke seal systems.

.3 Firestopping manual shall be submitted within 4 weeks of *Contract* award.

.4 Prior to concealment of firestopping conditions above a ceiling or by another assembly or finish, the *Contractor* shall submit an updated firestopping manual including as-built drawings that identify firestopping conditions and penetrations.

1.3 Closeout submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Submit the following certification documents with closeout submittals:

.1 Manufacturer’s certification: Submit manufacturer's certification that installed firestopping and smoke seal *Products* are suitable for the use indicated and comply with specified requirements.

.2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.

.3 As-built copy of the firestopping manual.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

1.1 WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHIMIS) REQUIRMENTS

1.2 Comply with Workplace Hazardous Materials Information System in accordance with the Occupational Health and Safety Act (OHSA) requirements.

1.3 Provide, before commencement of the Work and maintain for duration of Contract, a list with current Materials Safety Data Sheets (MSDSs) of all hazardous materials proposed for use on Project.

1.4 In addition to submission of MSDSs as required under regulations, submit emission reports where available or off-gassing data to help control possible harmful effects to indoor air quality during construction, occupation and including maintenance period.

1.5 Label hazardous materials used and/or supplied on Project in accordance with WHMIS requirements.

1.6 Provide detailed procedures for safe handling storage and use of hazardous materials. List special precautions and safe clean up and disposal procedures. Conform to Environmental Protection Act and other requirements of authorities for disposal and clean up requirements.

1.7 Obtain from Owner, where applicable, a list and MSDSs of hazardous materials that may be handled, stored or used by Owner's employees and/or other contractors retained by the Owner at location of the Work.

1.8 Ensure those who handle or are likely to handle or be exposed to hazardous materials are fully instructed and trained in accordance with WHMIS requirements.

1.10 WASTE DISPOSAL

.1 Obtain approval, and use following off-site disposal alternatives, depending upon materials involved; burying, composting, recycling, municipal collection, or local dump or sanitary landfill site.

.2 Handle hazardous materials in accordance with authorities having jurisdiction.

.3 Designate areas for storage of chemicals and hazardous wastes with security of access.

.4 Plan and provision for prevention and containment spills from entering drains.

1.11 UNEXPECTED DISCOVERY OF FRIABLE MATERIALS

.1 In event of unexpected discovery of friable material do no work that will disturb friable material until it is determined if friable material contains asbestos and immediately report discovery, inwriting, to Consultant. Consultant will authorize remedial work, if any, in writing. Do such remedial work, as addition to Contract.

.2 Take adequate precaution to avoid disturbing friable materials.

.3 Should such disturbed materials be suspected of containing asbestos, suspend work in area in question and immediately report, in writing to Consultant. Take immediate measures and protective efforts conforming to Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act as amended.

.4 Clean any contamination of surrounding areas affected in accordance with requirements of Construction Health and Safety Branch, Ministry of Labour. Consultant will authorize remedial work, if any, in writing. Execute such remedial work as addition to Contract.

END OF SECTION

1.1 REFERENCE STANDARDS

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

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

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

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

.5 Within the *Specifications*, reference may be made to the following standards writing, testing, or certification organizations by their acronyms or initialisms:
- .1 ANSI - American National Standards Institute
- .2 ASME - American Society of Mechanical Engineers
- .3 ASTM - American Society for Testing and Materials
- .4 AWMAC - Architectural Woodwork Manufacturers Association of Canada
- .5 CaGBC - Canadian Green Building Council
- .6 CGSB - Canadian General Standards Board
- .7 CSA - Canadian Standards Association
- .8 CSSBI - Canadian Sheet Steel Building Institute
- .9 ICEA - Insulated Cable Engineers Association
- .10 IEEE - Institute of Electrical and Electronics Engineers
- .11 MPP – Master Painters Institute
- .12 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
- .13 NAAMM - National Association of Architectural Metal Manufacturers
- .14 NEMA - National Electrical Manufacturers Association
- .15 NFPA - National Fire Protection Association
- .16 NLGA - National Lumber Grades Authority
- .17 SSPC – The Society for Protective Coatings
- .18 ULC - Underwriters' Laboratories of Canada

1.2 INDEPENDENT INSPECTION AND TESTING AGENCIES

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

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

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

1.3 INSPECTION AND TESTING AGENCY REPORTS

.1 For inspection and testing required by *Contract Documents* or by regulatory requirements, and performed by *Contractor* retained inspection and testing agencies, submit to *Consultant* and *Owner* copies of reports. Submit within 5 days after completion of inspection and testing.

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

MOCK-UPS

.1 Prepare mock-ups of *Work* as specified in the technical *Specifications*. If a mock-up location is not indicated in the *Drawings* or *Specifications*, locate where directed by *Consultant*.

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

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

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

.5 Unless otherwise specified in the technical *Specifications*, approved mock-ups forming part of the *Work* may remain as part of the *Work*.

.6 Remove mock-ups only when the *Work* they represent is complete or when otherwise directed by *Consultant*.

END OF SECTION

PART 1 - GENERAL

1.1 Related Requirements

.1 Quality Control – under Section 01 45 00.

.2 Materials and workmanship quality, reference standards - under Section 01 61 00.

.3 Balancing and testing of systems - under Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

1.2 Manufacturer's Field Review

.1 Where manufacturer's field review is specified, manufacturer's representative shall review the relevant parts of work at the *Place of the Work*, or wherever such affected work is in progress, to ensure that work is being executed in accordance with manufacturer's written recommendations and verify its product to be fit-for-purpose intended.

.2 Manufacturer's field review is to ensure that the *Products* specified are being used in the *Work* and are being applied on surfaces prepared in accordance with their recommendations and the requirements of the *Contract Documents*.

.3 Unless otherwise indicated, manufacturer's representative shall undertake a minimum of 1 field review, with additional reviews as deemed necessary by the manufacturer, to determine that the work of such sections is in accordance with the manufacturer's written recommendations.

.4 Manufacturer's representative shall submit a type written report on manufacturer's letterhead within 2 *Working Days* after each field review. Report shall document manufacturer's representative's field observations and recommendations.

.5 Manufacturer's field review reports to be prepared and distributed following the procedures specified for preparation and submittal of inspection and testing reports given in Section 01 45 00.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

1.1 TEMPORARY UTILITIES - GENERAL

.1 Provide temporary utilities as specified and as otherwise necessary to perform the *Work* expeditiously.

.2 Remove temporary utilities after use.

.1 Existing building heating, ventilation, power, and lighting may be relied upon and used during construction.

.2 Coordinate and make arrangements with the building operator for provision of these services during hours or days when the building is not operational.

1.2 TEMPORARY WATER SUPPLY

.1 Connect to and use *Owner*'s existing water supply for temporary use during construction, subject to existing available volume and pressure. Usage at no cost to *Contractor.*

.2 Arrange and pay for necessary water supply connections and disconnections.

1.3 TEMPORARY HEATING AND VENTILATION

.1 Arrange and pay for temporary heating and ventilation required during construction where the existing building systems are not sufficient to complete the *Work*.

.2 *Contractor* may connect to and use *Owner*'s existing supply of natural gas for temporary use during construction, subject to existing available volume and pressure. Reimburse *Owner*'s utility costs based on metered usage. Install a sub-meter for this purpose at *Contractor*'s cost.. Obtain written consent from Owner prior to usage.

.3 Use only flameless type of construction heaters where additional heat is being provided.

.4 Provide temporary heat for the *Work* as required to:

.1 Facilitate progress of *Work*.

.2 Protect the *Work* against dampness and cold.

.3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored *Products*.

.4 Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of *Products*.

.5 Provide temporary ventilation for the *Work* as required to:

.1 Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.

.2 Ensure that hazardous, noxious, or volatile substances do not migrate to *Owner* occupied spaces.

.3 Inform the *Owner* and the *Consultant* prior to commencement of the Work where hazardous or volatile adhesives, coatings or substances are used, and arrange to install adequate mechanical ventilation.

.4 Do not allow excessive build-up of moisture inside the building. Provide temporary, portable desiccant de-humidification system units designed to withstand the construction environment complete with portable, inflatable plastic duct type airflow systems to provide the proper drying required to establish the proper

humidity tolerances and prevent the growth of fungi (mould), at no additional costs to the *Owner.*

.6 New permanent building heating and ventilation systems may be used during construction, at *Contractor*'s option. If used during construction:

.1 *Owner* will pay utility costs resulting from the use of permanent systems.

.2 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.

.3 Just prior to *Substantial Performance of the Work*, replace filters, and perform other required maintenance to ensure systems are in as near as new condition as possible.

.4 Ensure that systems manufacturers' warranties do not commence until the date of *Substantial Performance of the Work* or, if manufacturers' warranties do commence earlier when systems are put into use, arrange for necessary extension of manufacturers' warranties or provide equivalent coverage under *Contractor*'s warranty.

1.4 TEMPORARY ELECTRICAL POWER AND LIGHTING

.1 Connect to and use *Owner*'s existing electrical supply for temporary use during construction. Usage at no cost to *Contractor*.

.2 Arrange and pay for necessary connections and disconnections of temporary power and lighting in accordance with regulatory requirements. Arrange for general temporary lighting throughout Work areas. Provide special task lighting required in the execution of the Work.

.3 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.

.4 Provide required extension cords from location where power is provided to location where it is needed.

.5 Provide sufficient lighting to ensure sufficient visibility for the proper execution, safety and inspection of the Work.

.6 Comply with Construction Safety Association's "Temporary Wiring Standards on Job Sites", the Ontario Electrical Code, and other authorities having jurisdiction.

END OF SECTION

1.1 BARRIERS AND ENCLOSURES - GENERAL

.1 Provide temporary barriers and enclosures necessary to protect the public and building occupants and to secure *Place of the Work* during performance of the *Work*.

.2 Comply with applicable regulatory requirements.

.3 Maintain temporary barriers and enclosures in good condition for the duration of the *Work*.

.4 Remove temporary barriers and enclosures from *Place of the Work* when no longer required.

1.2 WEATHER ENCLOSURES

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

.2 Provide weather enclosures to protect floor areas where walls are not finished and to enclose work areas that require temporary heating.

.3 Design weather enclosures to withstand wind pressure and snow loading requirements.

1.3 DUST TIGHT SCREENS AND PARTITIONS

.1 Provide temporary dust tight partitions and screens where nature of Work requires access to floor areas above or below the floor being worked on to control dust migration and/or as specified herein and/or noted on Drawings.

.2 Separate construction areas from occupied areas. Construct dust tight and wind proof screens to completely enclose the Work areas and the access passages to the Work areas from the other areas of the existing building(s).

.3 Coordinate location of dust tight partitions, screens, weather barriers and doors with the Owner. Obtain the Owner's approval of installed dust tight partitions, screens, weather barriers, protective coverings and protection methods before proceeding with the renovation/alteration work.

.4 Protective coverings shall be fire retardant coated, dust-proof fabric of premium grade, weighing minimum of 4.3 oz/sq. yd. (145 g/m2), Polyweave® Flame -Retardant Fabric by Polytrap Products, or P9M Fire Retardant Fabric by Inland Plastics Ltd., or other manufacturer acceptable to the Owner.

.5 Fabricate and erect partitions of 3-5/8" (92mm) metal studs at 16" (450mm) O.C., with 1/2"(13mm) gypsum board on both sides with closed joints. Maintain height indicated on Drawings or as required to provide dust proof separation.

.6 Tape or seal between adjacent boards and provide painted finish.

.7 Seal perimeter of cut outs around fixtures, fittings and penetrations.

.8 Extend screens from floor to underside of structure above unless otherwise shown, noted or approved otherwise.

.9 Where applicable, construct screen partitions to provide required fire resistance ratings and smoke-tight separation to the approval of the authorities having jurisdiction.

.10 Where exposed to the weather, fully cover the temporary screens with a heavy waterproof and dust proof fabric or polyethylene with lapped and sealed joints. Where required to have sound attenuation, fill spaces between studs

with 4" (100mm) thick, glass fibre or mineral fibre insulation batts to deaden sound.

.11 Thoroughly pack framing at junctions of screens with floors, walls and underside of structure with batt insulation and seal in a manner to prevent infiltration of dust, dirt, etc. Ensure that rooms within closed off areas which are not being altered are kept dust free.

.12 Install temporary packing at bottom of doors through screens and to elevator entrances not being used during demolition and construction. Prevent dust seepage into existing adjacent spaces and occupied areas.

.13 Provide daily vacuuming of construction dust from corridors and connecting areas as the Work progresses. This shall be considered a minimum requirement; increase vacuuming as necessary. The Owner may have vacuuming work done by others and cost deducted from Contractor's progress payments if this requirement is not fulfilled.

1.4 EMERGENCY EXITS AND FIRE ROUTES

.1 Maintain access to the use of the emergency exit facilities in the occupied areas of the existing building.

.2 Do not block or in any way utilize vehicular fire routes in a manner which would adversely affect the usefulness of the routes for firefighting and safety purposes at the existing building.

1.5 PROTECTION OF BUILDING FINISHES

.1 Provide necessary temporary barriers and enclosures to protect existing and completed or partially completed finished surfaces from damage during performance of the *Work*.

END OF SECTION

1.1 TEMPORARY CONTROLS - GENERAL

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

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

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

1.2 DUST AND PARTICULATE CONTROL

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

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

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

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

1.3 POLLUTION CONTROL

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

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

.1 authority having jurisdiction,

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

.3 *Owner* and *Consultant*.

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

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

END OF SECTION

1.1 GENERAL

.1 Provide *Products* that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by *Consultant*, furnish evidence as to type, source and quality of *Products* provided.

.2 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.

.3 Permanent manufacturer's markings, labels, trademarks, and nameplates on *Products* are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

1.2 PRODUCT OPTIONS

.1 Subject to the provisions of Section 01 25 00 –Substitution Procedures:

.1 Wherever a *Product* or manufacturer is specified by a single proprietary name, provide the named *Product* only.

.2 Wherever more than one *Product* or manufacturer is specified by proprietary name for a single application, provide any one of the named *Products*.

.2 Wherever a *Product* is specified by reference to a standard only, provide any *Product* that meets or exceeds the specified standard. If requested by *Consultant*, submit information verifying that the proposed *Product* meets or exceeds the specified standard.

.3 Wherever a *Product* is specified by descriptive or performance requirements only, provide any *Product* that meets or exceeds the specified requirements. If requested by *Consultant*, submit information verifying that the proposed *Product* meets or exceeds the specified requirements.

1.3 PRODUCT AVAILABILITY AND DELIVERY TIMES

.1 Promptly upon Contract award and periodically during construction, review and confirm *Product* availability and delivery times. Order *Products* in sufficient time to meet the construction progress schedule and the *Contract Time*.

.2 If a specified *Product* is no longer available, promptly notify *Consultant*. *Consultant* will take action as required.

.3 If delivery delays are foreseeable, for any reason, promptly notify *Consultant*.

.1 If a delivery delay is beyond *Contractor*'s control, *Consultant* will provide direction.

.2 If a delivery delay is caused by something that was or is within *Contractor*'s control, *Contractor* shall propose actions to maintain the construction progress schedule for *Consultant*'s review and acceptance.

1.4 STORAGE, HANDLING, AND PROTECTION

.1 Store, handle, and protect *Products* during transportation to *Place of the Work* and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.

.2 Comply with manufacturer's instructions for storage, handling and protection.

.3 Store packaged or bundled *Products* in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in *Work*.

.4 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of material safety data sheets (MSDS).

.5 Store *Products* subject to damage from weather in weatherproof enclosures.

.6 Store sheet *Products* on flat, solid, supports and keep clear of ground. Slope to shed moisture.

.7 Remove and replace damaged *Products*.

END OF SECTION

1.1 EXISTING UTILITIES AND STRUCTURES

.1 Before commencing excavation, drilling or other earthwork, establish or confirm location and extent of all existing underground utilities and structures in work area.

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

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

1.2 VERIFICATION OF EXISTING CONDITIONS

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

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

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

.4 Notify *Consultant* in writing of unacceptable conditions.

END OF SECTION

1.1 SUMMARY

.1 Except where otherwise specified in technical *Specifications* or otherwise indicated on *Drawings*, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Install, erect, or apply *Products* in strict accordance with manufacturer's instructions.

.2 Notify *Consultant*, in writing, of conflicts between *Contract Documents* and manufacturer's instructions where, in *Contractor*'s opinion, conformance with *Contract Documents* instead of the manufacturer's instructions may be detrimental to the *Work* or may jeopardize the manufacturer's warranty.

.3 Do not rely on labels or enclosures provided with *Products*. Obtain written instructions directly from manufacturers.

.4 Provide manufacturer's representatives with access to the *Work* at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 CONCEALMENT

.1 Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:

.1 after review by *Consultant* and authority having jurisdiction, and
.2 where locations differ from those shown on *Drawings*, after recording actual locations on as-built drawings.

.2 Provide incidental furring or other enclosures as required.

.3 Notify *Consultant* in writing of interferences before installation.

1.4 FASTENINGS - GENERAL

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

.2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.

.3 Use non-corrosive fasteners and anchors for securing exterior work.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.

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

.6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.5 FASTENINGS - EQUIPMENT

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

.2 Bolts shall not project more than one diameter beyond nuts.

1.6 FIRE RATED ASSEMBLIES

.1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.7 LOCATION OF FIXTURES, OUTLETS AND DEVICES

.1 Consider location of fixtures, outlets, and devices indicated on *Drawings* as approximate unless dimensioned or specifically noted.

.2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.

.3 Promptly notify *Consultant* in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

1.8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

.1 Adequately protect parts of the *Work* completed and in progress from any kind of damage.

.2 Promptly remove, replace, clean, or repair, as directed by *Consultant,* work damaged as a result of inadequate protection.

.3 Do not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety or integrity of the *Work*.

1.9 REMEDIAL WORK

.1 Notify *Consultant* of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

END OF SECTION

1.1 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

.1 Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:

.1 Structural integrity of any element of the *Work*.
.2 Integrity of weather-exposed or moisture-resistant elements.
.3 Efficiency, maintenance, or safety of any operational element.
.4 Visual qualities of sight-exposed elements.
.5 Work of *Owner* or other contractors.
.6 Warranty of *Products* affected.

.2 Include in request:

.1 Identification of *Project*.
.2 Location and description of affected work, including drawings or sketches as required.
.3 Statement on necessity for cutting or alteration.
.4 Description of proposed work, and *Products* to be used.
.5 Alternatives to cutting and patching.
.6 Effect on work of *Owner* or other contractors.
.7 Written permission of affected other contractors.
.8 Date and time work will be executed.

1.2 PRODUCTS

.1 Unless otherwise specified, when replacing existing or previously installed *Products* in the course of cutting and patching work, use replacement *Products* of the same character and quality as those being replaced.

.2 If an existing or previously installed *Product* must be replaced with a different *Product*, submit request for substitution in accordance with Section 01 25 00 - Substitution Procedures.

1.3 PREPARATION

.1 Inspect existing conditions in accordance with Section 01 71 00 - Examination and Preparation.

.2 Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of the *Work* from damage.

.3 Provide protection from elements for areas that may be exposed by uncovering work.

1.4 EXISTING UTILITIES

.1 Where the *Work* involves breaking into or connecting to existing services, submit shutdown request to *Owner* 7 business days' and/or 14 business days' notice if fire safety interruption that requires fire watch for necessary interruption of mechanical or electrical services. All shutdowns shall be performed within approved shutdown window.

.1 Maintain excavations free of water.

.2 Keep duration of interruptions to a minimum.

.3 Carry out interruptions after regular working hours of occupants, preferably on weekends, unless *Owner*'s prior written approval is obtained.

.4 Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.

.5 Construct or erect barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures as required to protect pedestrian and vehicular traffic.

1.5 CUTTING, PATCHING, AND REMEDIAL WORK

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

.2 Perform cutting, fitting, patching, and remedial work to make the affected parts of the *Work* come together properly and complete the *Work*.

.3 Provide openings in non-structural elements of the *Work* for penetrations of mechanical and electrical work.

.4 Perform cutting by methods to avoid damage to other work

.5 Provide proper surfaces to receive patching, remedial work, and finishing.

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

.7 Do not use pneumatic or impact tools without *Consultant*'s prior approval.

.8 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.

.9 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.

.10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.

1.6 CORE DRILLING

.1 Conform to following procedures unless otherwise specified. Conform to most severe requirements.

.2 Do not cut reinforcing bars to *Install* anchors or perform core drilling.

.3 Existing reinforcing bars in concrete structure may conflict with specific anchor locations or core drilling requirements. Review existing *Drawings* where available and undertake to locate position of reinforcing bars at locations of core drilling.

.4 Prior to core drilling, approval shall be obtained in writing from *Consultant* regarding method of verification and examination of substrate.

.5 Carry out examination of substrate through Ground Penetrating Radar system (GPR), or Portable Steel Reinforcement Detection system - PS 200Ferroscan by Hilti Corporation; www.hilti.com.

.6 Avoid cutting through critical reinforcement and costly reinforcement bar contacts, electrical, ITS and conduits. *Provide* software for office analysis and easy creation of reports.

.7 Be responsible for ensuring appropriate system is selected to suit site conditions.

.8 Carry out examination over larger area and where conflicts with existing systems are encountered. Obtain *Consultant's* approval for relocation of cutting and core drilling. Rescan as required until satisfactory location is found for cutting and drilling process.

.9 Examination shall include: slab thickness, verification of concrete cover over reinforcement, rebar pattern identification, bar diameter and locations, detection of post tension cables, location of metallic and non-metallic pipes and conduits, detection of voids and concrete heterogeneity, measurement of slab on grade and location of pipes and cables under slab on grade.

.10 Use of X-ray for scanning concrete shall be approved by *Consultant* and *Owner* and only used where GPR would likely be not successful. Ensure availability of access to both sides. Hole locations shall be X-rayed prior to drilling. *Contract Price* includes cost of conducting X-ray examination and radiation shielding barrier during premium time after normal working hours. *Provide* special handling and containment to avoid serious exposure to workers and passers-by. Conform to the Occupational Health and Safety Act requirements for safety of staff and workers.

.11 For ground penetrating radar system for slab on grade, obtain verification that GPS examination can be carried out. Ensure availability of access. *Contract Price* includes cost of conducting ground penetrating radar system examination during premium time after normal working hours.

.12 *Provide* on-site analysis and reporting complete with computer reporting including photographs and colour maps.

.13 Whenever core drilling is required, *Provide* temporary dust proof screen as specified in *Contract Documents*.

.14 In areas where core drilling through existing slab is necessary, areas to be drilled shall be marked out clearly on underside of slab. *Owner*'s representative shall be notified at least 1week prior to core drilling operation. *Provide* dustproof neoprene coated nylon tarpaulin forcovering existing equipment in area of work.

.15 During all core drilling operations, ensure that a minimum of one person is stationed directly below area of core drilling with a large plastic container pressed to underside of slab to hold core debris and water due to operations.

.16 Use wet/dry commercial quality vacuum cleaning equipment continuously at location of drilling operation to remove debris and water.

.17 After cutting and patching is completed, re-finish surfaces to minimum 100 mm (4") outside patch perimeter, floor to ceiling and to nearest break in wall surfaces, such as inside and outside corners. Match patch finish to existing adjacent surfaces to completely conceal patch.

1.7 CUTTING AND PATCHING - FIRE SEPARATION ALTERATIONS

.1 Maintain fire separations for duration of work of this Section.

.2 *Provide* fire and smoke penetration sealants at alterations and repairs in fire separations.

.3 *Provide* fire and smoke penetration sealants to seal properly pipes, sleeves, ducts, conduit and other penetrations through surfaces.

.4 *Provide* continuous and solid framing, blocking or masonry work around service penetrations through fire separations in accordance with the fire penetration sealant design to maintain the continuity of the fire separation.

1.8 CUTTING AND PATCHING - MECHANICAL, ELECTRICAL AND OTHER MISCELLANEOUS ALTERATIONS

.1 *Provide* cutting and patching required for access to execute services alterations. Conceal capped services unless specifically indicated to remain exposed. Patch to conceal altered and capped services.

.2 *Provide* cutting and core drilling of existing concrete and masonry walls and slabs as required to pass services through existing assemblies to accommodate alterations.

.3 Cutting and patching shall be located and paid for by *Subcontractors* requiring work performed for their

installations. Such work shall be done by experienced workers in conformance with requirements of appropriate mechanical Section. Work shall be performed under direct supervise on of *Contractor*.

.4 In carrying out renovation work in occupied areas, minimize exposure of occupied spaces to work areas above finished ceiling. Remove only limited ceiling panels and complete work in those areas within 2 *Working Days.* Immediately reinstall, replace or repair removed ceiling before further removal of ceilings is carried out.

.5 Mechanical and electrical alterations and repair work may be outside of areas anticipated for architectural renovations. *Contract Price* includes cutting, patching, repair and alterations beyond *The Work* site limit. *Subcontractors* requiring work to be performed for their installations shall include for all removals, repair, alterations and reinstallations as necessary to complete their work.

END OF SECTION

1.1 REGULATORY REQUIREMENTS

.1 Comply with applicable regulatory requirements when disposing of waste materials.

.2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

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

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

.3 Prevent cross-contamination during the cleaning process.

.4 Notify the *Consultant* of the need for cleaning caused by *Owner* or other contractors.

1.3 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

.1 Maintain the *Work* in a tidy and safe condition, free from accumulation of waste materials and construction debris.

.2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables.

.3 Waste containers and bins shall be “closed box“ type to prevent the waste materials from being wind-blown and contaminating the *Owner*’s property, adjacent private and Public properties.

.4 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each *Working Day*. Collect packaging materials for recycling or reuse.

.5 Remove waste materials and recyclables from *Place of the Work* daily.

.6 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.

.7 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

.8 The location(s) of the waste containers and bins shall be to the acceptance of the *Owner*. The *Owner* reserves the right to have the location(s) of the waste containers and bins re-located as required to suit the operations of the *Owner* and the building(s) at no additional cost to the *Owner*.

.9 Contractor and/or his subcontractors shall not use the *Owner*’s and or the existing building’s waste containers and bins for disposal of demolition waste and construction waste. If after investigation by the *Owner*, it is discovered that the Contractor or his subcontractors have used the *Owner*’s and or the existing building(s) waste containers and bins for disposal of demolition waste and/or construction waste, the *Owner* reserves the right to back charge the said Contractor, deduct the equivalent costs from the Contractor’s next progress payment for the use of the said waste containers and bins.

1.4 FINAL CLEANING

.1 Remove from *Place of the Work* surplus *Products*, waste materials, recyclables, *Temporary Work*, and *Construction Equipment* not required to perform any remaining work.

.2 Provide professional cleaning by a qualified, established cleaning company.

.3 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.

.4 Re-clean as necessary areas that have been accessed by *Contractor*'s workers prior to *Owner* occupancy.

.5 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, floors and doors.

.6 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and all other finished surfaces, including mechanical and electrical fixtures. Replace broken, scratched or otherwise damaged glass.

.7 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.

.8 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens.

.9 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.

.10 Remove waste material and debris from crawlspaces and other accessible concealed spaces.

.11 Remove stains, spots, marks, and dirt from exterior facades.

.12 Clean interior window glass and frames.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.

.2 Do not burn or bury waste materials at *Place of the Work*.

.3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from *Place of the Work*, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.

.4 Cover or wet down dry waste materials to prevent blowing dust and debris.

END OF SECTION

1.1 READY-FOR-TAKEOVER

.1 The prerequisites to attaining *Ready-for-Takeover* of the *Work* are described in the General Conditions of the *Contract*.

1.2 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER

.1 *Contractor*'s Inspection: Before applying for the *Consultant*'s review to establish *Ready-for-Takeover* of the *Work*:

.1 Ensure that the specified prerequisites to *Ready-for-Takeover* of the *Work* are completed.

.2 Conduct an inspection of the *Work* to identify defective, deficient, or incomplete work.

.3 Prepare a comprehensive and detailed list of items to be completed or corrected.

.4 Provide an anticipated schedule and costs for items to be completed or corrected.

.2 *Consultant*'s Review: Upon receipt of the *Contractor*'s application for review, together with the *Contractor*'s list of items to be completed or corrected, the *Consultant* and the *Contractor* shall arrange a mutually satisfactory agreed date and time to jointly review the *Work*. The *Consultant* will advise the *Contractor* whether or not the *Work* is *Ready-for-Takeover*. Add additional items, if any, to the *Contractor*'s list of items to be completed or corrected. Provide the *Consultant* with a copy of the revised list.

.3 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor's inspection and *Consultant*'s review procedures specified above shall be repeated until the *Work* is *Ready-for-Takeover* and no items remain on the *Contractor*'s list of items to be completed or corrected.

.4 When the *Consultant* determines that the *Work* is *Ready-for-Takeover*, the *Consultant* will notify the *Contractor* and the *Owner* in writing to that effect.

.5 City of Mississauga permit closure from all departments and occupancy approval

1.3 PREREQUISITES TO FINAL PAYMENT

.1 After *Ready-for-Takeover* of the *Work* and before submitting an application for final payment in accordance with the General Conditions of Contract:

.1 Correct or complete all remaining defective, deficient, and incomplete work.

.2 Remove from the *Place of the Work* all remaining surplus *Products*, *Construction Equipment*, and *Temporary Work*.

.3 Perform final cleaning and waste removal necessitated by the *Contractor*'s work performed after *Ready-for-Takeover*, as specified in Section 01 74 00 – Cleaning and Waste Management.

1.4 PARTIAL USER OCCUPANCY

.1 If partial *Owner* occupancy of a part of the *Work* is required before the date of *Ready-for-Takeover* of the entire *Work* of the *Contract,* the provisions of this Section shall apply, to the extent applicable, to that part of the *Work* that the *Owner* intends to occupy.

1.5 SUBSTANTIAL PERFORMANCE OF THE WORK

.1 The prerequisites to, and the procedures for, attaining substantial performance of the *Work*, or similar such milestone as provided for in the lien legislation applicable to the *Place of the Work*, shall be:

.1 independent of those for attaining *Ready-for-Takeover* of the *Work*, and

.2 in accordance with the lien legislation applicable to the *Place of the Work*.

END OF SECTION

1.1 OPERATION AND MAINTENANCE MANUAL

.1 Prepare a comprehensive operation and maintenance manual, in the language of the *Contract*, using personnel qualified and experienced for this task.

.2 Submit an initial draft of the operation and maintenance manual for *Consultant*'s review. If required by *Consultant*'s review comments, revise manual contents and resubmit for *Consultant*'s review. If required, repeat this process until *Consultant* accepts the draft manual in writing.

.3 Submit final version to *Owner* in hard copy and electronic format. Provide two hard copies and one USB key.

1.2 OPERATION AND MAINTENANCE MANUAL FORMAT

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, three D-rings, loose leaf, 216 x 279 mm, with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with typed or printed title “Operation and Maintenance Manual”, name of Project or facility, and subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate *Product* or system, with typed description of *Product* and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide electronic copy of manual in PDF format.

.10 Provide electronic copy of Shop *Drawings* in manual as 1:1 format on USB flash drive or other electronic media acceptable to *Owner*.

1.3 OPERATION AND MAINTENANCE MANUAL – GENERAL CONTENT

.1 Table of contents for each volume.

.2 Introductory information including:

.1 Date of manual submission.

.2 Complete contact information for *Consultant*, subconsultants, other consultants, and *Contractor*, with names of responsible parties.

.3 Schedule of *Products* and systems indexed to content of volume.

.4 For each *Product* or system, include complete contact information for *Subcontractors*, *Suppliers* and manufacturers, including local sources for supplies and replacement parts.

.5 *Product* Data: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.

.6 Reviewed *Shop Drawings*.

.7 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.

.8 Warranties.

.9 Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.

.10 Training materials as specified in Section 01 79 00 - Demonstration and Training.

1.4 OPERATION AND MAINTENANCE MANUAL - EQUIPMENT AND SYSTEMS CONTENT

.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 Panel Board 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, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly 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 list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide *Contractor*'s coordination 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 list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include testing and balancing reports.

.15 Include additional content as specified in technical *Specifications* sections.

1.5 OPERATION AND MAINTENANCE MANUAL - PRODUCTS AND FINISHES CONTENT

.1 Include *Product* data, with catalogue number, options selected, 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 Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.

.4 Include additional content as specified in technical *Specifications* sections.

1.6 OPERATION AND MAINTENANCE MANUAL - WARRANTIES CONTENT

.1 Separate each warranty with index tab sheets keyed to Table of Contents listing.

.2 List each warrantor with complete contact information.

.3 Verify that documents are in proper form and contain full information. Ensure that warranties are for the correct duration and are in *Owner*'s name.

1.7 CONTRACTOR'S AS-BUILT DRAWINGS

.1 Submit final as-built drawings in the form specified in Section 01 32 00 – Construction Progress Documentation to *Consultant* for review. After Consultant has reviewed and accepted all As-Built drawings, submit final drawings to Owner.

1.8 PROJECT RECORD DRAWINGS

.1 Transfer all information marked up on the as-built drawings during the progress of the *Work* to a master set of record drawing files provided by *Consultant*, in AutoCAD electronic format.

.2 Mark revised drawings as "RECORD DRAWINGS".

.3 Submit completed record drawings in hard copy and electronic form to *Owner*. Provide two hard copy sets.

1.9 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

.1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical *Specifications* sections.

.2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed *Products*.

.3 Provide tags for special tools identifying their function and associated *Product*.

.4 Deliver to and store items at location directed by *Owner* at *Place of the Work*. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.

.5 Catalogue all items and submit to *Consultant* an inventory listing organized by *Specifications* section. Include *Consultant* reviewed inventory listing in operation and maintenance manual.

END OF SECTION

1.1 SUMMARY

.1 Demonstrate and provide training to *Owner*'s personnel on operation and maintenance of equipment and systems prior to scheduled date of *Substantial Performance of the Work*.

.2 *Owner* will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.

.3 Coordinate and schedule demonstration and training provided by *Subcontractors* and *Suppliers*.

1.2 SUBMITTALS

.1 Submit proposed dates, times, durations, and locations for demonstration and training of each item of equipment and each system for which demonstration and training is required. Allow sufficient time for training and demonstration for each item of equipment or system, or time as may be specified in technical *Specifications*.

.2 *Consultant* and *Owner* will review submittal and advise *Contractor* of any necessary revisions.

.3 Submit report(s) within 5 *Working Days* after completion of demonstration and training:

.1 identifying time and date of each demonstration and training session,
.2 summarizing the demonstration and training performed, and
.3 including a list of attendees.

1.3 PREREQUISITES TO DEMONSTRATION AND TRAINING

.1 Testing, adjusting, and balancing has been performed in accordance with *Contract Documents*.

.2 Equipment and systems are fully operational.

.3 Copy of completed operation and maintenance manual is available for use in demonstration and training.

.4 Conditions for demonstration and training comply with requirements specified in technical *Specifications*.

1.4 DEMONSTRATION AND TRAINING

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment and system.

.2 Review operation and maintenance manual in detail to explain all aspects of operation and maintenance.

.3 Prepare and insert additional information in operation and maintenance manual if required.

END OF SECTION

1.1 CONTRUCTION FACILITIES – GENERAL

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

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

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

1.2 CONSTRUCTION PARKING

.1 There is no free parking to anyone at the Place of the Work. The University of Toronto Mississauga campus is regularly patrolled and violators will be ticketed and/or towed. Contractors working on campus must have one of the following:
  .1 Cash parking receipt (obtained from machine or Kiosk).
  .2 Commercial parking permit.

.2 The University of Toronto Mississauga campus has a severe shortage of parking spaces. However, a limited number of commercial permits on a weekly or monthly basis can be made available for the use of contractors who are involved in University construction projects and who must have access to vehicles in the normal course of their duties with the University.

.3 Parking permits are not available to construction workers whose primary requirement for parking is transportation to and from the construction site. A limited number of cash parking spaces is available to University visitors. All individuals are encouraged to use public transportation whenever possible.

.4 The Owner's Parking Manager has the sole authority to issue a commercial permit. Requests for commercial permits must be accompanied by an "Application for a Commercial Parking Permit" signed by the Owner's representative.

.5 If due to the nature of the Work, parking for equipment must be provided in a non-designated parking location, special permission must be granted by the Owner.

.6 Abide by the University of Toronto "Automobile Parking Regulations". Failure to do so may result in ticketing, towing and/or revoking of parking privileges.

.7 Ensure permit is displayed prominently on dash to avoid issuance of parking infraction notice.

.8 Contractor shall be responsible for all vehicles working on this Project.

1.3 SITE OFFICES

.1 The Owner may provide room for office and storage requirements. Be responsible to review this area and ascertain its suitability for purpose intended.

1.4 SANITARY FACILITIES

.1 Existing washrooms in the building may be used by the Contractor.

.2 Keep sanitary facilities clean.

1.5 FIRE PROTECTION

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

.2 Provide and maintain in proper order, minimum of one (1) fire extinguisher in each work area or more if directed by the Owner or Consultant, prominently placed, until completion of Work.
.3 Fire extinguishers shall be minimum 19.84 lbs. (9kg.), 4A-60BC type.
.4 Remove fire extinguishers from the Place of the Work upon completion of Work or when directed by the Owner or Consultant.
.5 Where gas welding or cutting is to be done within 3000mm or above combustible material, or above space that may be occupied by persons, interpose shields of noncombustible material. Place tanks supplying gases for welding or cutting at no greater distance from the Work than is necessary and securely fasten in an upright position. Keep tanks free from exposure to the sun or high temperature
.6 Hot Work Permit:

.1 A Contractor's Hot Work Permit must be submitted in writing to the Owner for any and all work involving open flame, cutting, grinding, soldering or welding in occupied facilities. For clarification, all existing building and tunnel are considered occupied facilities. Contractor's Hot Work Permit to contain, at a minimum, the following information:
.1 Company performing hot work
.2 Location of hot work
.3 Nature of hot work
.4 Duration of hot work
.5 Name and contact information of person performing the work and of the person supervising hot work
.6 Protection method against false fire alarms and/or sprinkler activation
.7 Precautions being taken

.2 Submit permit a minimum of 7 business days' or 14 business days', if fire watch is required, in advance of commencing hot work. Do not perform hot work without Owner's written approval or sign-off on the Contractor's proposed Hot Work Permit.

.3 Approved Hot Work Permit must be clearly displayed on site at the location of the hot work.

1.6 USE OF EXISTING ELEVATORS

.1 One designated elevator may be used by construction personnel and for transporting Products during limited hours and days. Co ordinate use with Owner.
.2 Provide protective coverings for finish surfaces of cars and entrances. Assume responsibility for and make good any damage to existing elevators caused by construction personnel.
.3 Construction personnel may have use of other elevators for transporting their persons only to and from the area(s) of the Work during limited hours and as designated by the Owner.
.4 Co-ordinate delivery times of smaller construction materials and products with the restricted hours of elevator use.
.5 The Owner reserves the right at certain times and circumstances restrict use of the elevator(s), especially where it interferes with operation of the existing building(s). If the preceding occurs, the Contractor shall make arrangements with the Owner for temporarily extending the restricted hours use, or having alternate hours use of the elevator(s).

1.7 TEMPORARY SIGNS
.1 Except as specified herein, do not erect temporary signs.
.2 Erect signs relating to safety on the Work, or mandatory regulation notices.
.3 Prior to commencement of Work wherein hazardous or volatile cements, coatings, or substances are used, barricade entire area and post adequate number of "NO SMOKING" signs.
.4 Contractor will be permitted to put his own sign on the hoarding subject to the Owner's review and approval.
.5 For temporary way finding directional, information and warning signage, and warning marking tapes refer to Section 01 35 00 - Special Procedures.

END OF SECTION

1 **PART 1 - GENERAL**

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 **RELATED WORK**

1.1.1 Lead Disturbance Procedures: Section 02 13 85

1.1.2 Silica Disturbance Procedures: Section 02 13 86

1.1.3 Mercury Removal Procedures: Section 02 13 87

1.2 DESCRIPTION OF WORK

1.2.1 Types of asbestos present: Chrysotile present within vinyl floor tile/associated mastic. Asbestos containing materials identified can be found within Safetech Environmental Limited report titled "*Hazardous Building Materials Assessment – UTM Project # 2017-18-17, DV ERS/GGR/HCC Phase 2 and Phase 3 Renovation Project*" issued on June 17, 2018 and November 26, 2019. A copy of this report can be found within the contract documents.

TABLE I
Summary of Asbestos Containing Materials for Abatement
UTM Project # 2017-18-17, *DV ERS/GGR/HCC* Renovation Project

Location Description	Material	Quantity	Type of Asbestos	Condition	Friable	Operation
● **Room # 1150K**	Vinyl Asbestos Floor Tile & Asbestos Mastic	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement.
* **Room # 1157k**	Asbestos Mastic Below Vinyl Sheet Flooring	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement. Include VSF.
* **Room # 1159v**	Vinyl Asbestos Floor Tile & Asbestos Mastic	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement.
Room # 1153, a,b,c	Vinyl Asbestos Floor Tile & Asbestos Mastic	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement.
* **Room # 1154b**	Vinyl Asbestos Floor Tile & Asbestos Mastic	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement.
Room # 1156, a, b, c, d, e	Vinyl Asbestos Floor Tile & Asbestos Mastic (under carpet)	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement.
* **Room # 1157a**	Blue Vinyl Floor Tile & Asbestos Mastic	Refer to Project Drawings	*Chrysotile*	Good	N	Type 2 Abatement. Include Blue VFT.

* Already covered in Phase 2 project ● Partially covered in Phase 2 project

1.2.2 As per University of Toronto policy (ID R2.30), Type 2 operations must be utilized when removing more than 1000 sq. ft. of vinyl floor tile or where many tiles cannot be

removed intact (without breaking into smaller pieces).

1.2.3 Type 2 operation (full enclosure method and negative pressure) must be utilized when removing vinyl floor tile and adhesive mastic compounds. Adhesive mastic/leveling compounds shall be removed, completely to the concrete floor finish by using grinders (Diamatic 780PRO or equivalent) equipped with an individual dust collecting assembly. If the grinders are not equipped with individual dust collecting assembly, the work shall be done following Type 3 operations with no additional cost to the University of Toronto. Adhesive mastic/leveling compound removal from congested spots or edges shall be performed by small hand grinders. Ensure all sub-contractors that may participate in this operation have a minimum of Asbestos Type 1 & 2 Training including Respirator Fit Testing - 4.0 hour duration. Chemical removal of the mastic may be used as a viable alternative as approved by the University of Toronto Mississauga's Project Manager.

1.2.4 Perform asbestos removal by full enclosure method.

1.2.5 Maintain electrical and mechanical services passing through asbestos work area.

1.2.6 Seal all surfaces from which asbestos has been cleaned or removed with slow drying sealer.

1.2.7 Dispose of temporary enclosures, disposable equipment and any asbestos-containing or contaminated materials removed, as asbestos waste.

1.2.8 All work will be subject to inspection and air monitoring both inside and outside asbestos work area by Owner's Consultant. Any contamination of surrounding areas (indicated by visual inspection or air monitoring) shall necessitate complete enclosure and clean-up of affected areas.

1.3 DEFINITIONS

1.3.1 **HEPA Filter**: High Efficiency Particulate Aerosol filter at least 99.97 percent efficient in collecting 0.3 micrometer aerosol.

1.3.2 **Friable Material**: Material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

1.3.3 **Polyethylene Sheeting**: Polyethylene sheeting 0.15 mm (6 mil) minimum thickness; with tape seals along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous polyethylene membrane protection.

1.3.4 **Authorized Visitor(s)**: Construction Manager or person(s) representing regulatory agencies, and person(s) authorized by them.

1.3.5 **Asbestos Work Area(s)**: Area(s) where work takes place which will, or may disturb asbestos-containing material, including overspray and fallen material, or settled dust that may contain asbestos.

1.3.6 **Curtained Doorway**: Device to allow ingress or egress from enclosure while permitting minimal air movement, typically constructed by placing 2 overlapping flaps of polyethylene sheeting (2 sheets of polyethylene per flap) attached to head and 1 jamb of existing or temporarily constructed door frame. Secure vertical edge of 1 flap along 1 vertical side of door frame, and vertical edge of other flap along opposite vertical side of door frame. Reinforce free edges of polyethylene with duct tape.

1.3.7 **Negative Pressure**: Reduced pressure within asbestos work area(s) established by extracting air directly from work area, and discharging directly to exterior of building. Discharged air first passes through HEPA filter. Extract sufficient air to ensure constant reduced pressure at perimeter of work area with respect to surrounding areas.

1.3.8 **Airlock**: 2 curtained doorways spaced minimum of 2 m (6') apart.

1.4 QUALITY ASSURANCE

1.4.1 Ensure work proceeds to Schedule and meets all requirements of this Section. Perform work so airborne asbestos, asbestos waste or water run off does not contaminate areas outside asbestos work enclosure.

1.4.2 Pay cost to Owner of inspection and air monitoring performed as result of failure to perform work satisfactorily.

1.4.3 Use only skilled and qualified workers for all trades required for this work.

1.5 REGULATIONS

1.5.1 Comply with Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations made under Occupational Health and Safety Act, Reg. 278/05, as amended, and local requirements pertaining to asbestos; provided that in case of conflict with these Specifications most stringent requirements shall apply.

1.5.2 Handle and dispose of contaminated waste as required by Ontario Regulation 347 (as amended), made under The Environmental Protection Act, as amended.

1.6 SUBMITTALS

1.6.1 Before Commencing Work: Obtain and submit all necessary permits for transporting and disposal of asbestos waste.

1.6.1.1 Submit names of supervisory personnel who will be responsible for asbestos work area(s). One of supervisors must remain on Site at all times while asbestos removal or clean-up is occurring. Submit proof that supervisory personnel have attended training course on asbestos control (2 day minimum duration) and have performed supervisory function on at least 2 other asbestos control projects.

1.6.1.2 Submit proposed schedule showing phasing and proposed workforce related to each work area enclosure or repair operation.

1.6.1.3 Submit list of existing damage for acceptance.

1.7 WORKER AND VISITOR PROTECTION

1.7.1 **Instructions**: Before entering asbestos work area(s), instruct workers and visitors in use of respirators, entry and exit from enclosures and all aspects of work procedures and protective measures. Instruction shall be provided by competent person as defined by Occupational Health and Safety Act.

1.7.2 **Full Face Respirator**: Provide appropriate respiratory equipment for all persons within asbestos work area including authorized visitors. During specified work, workers,

supervisors, and authorized visitors shall wear negative pressure half-face respirators with minimum P100 filter cartridges in accordance with NIOSH Part 84 requirements (Formerly high efficiency particulate aerosol (HEPA) cartridge filters). Replace filters daily or test according to manufacturer's specifications and replace as indicated. Respirators shall be acceptable to Occupational Health Branch of Ministry of Labour. Provide proper instruction to workers and visitors on use of respirators, including qualitative fit testing. No supervisor, worker or authorized visitor shall wear facial hair which affects seal between respirator and face. Maintain respiratory protection equipment in proper functioning and clean condition, or remove from site.

1.7.3 **Protective Clothing:** Provide workers and visitors in full-enclosure sites with full body coveralls with integral hoods. Once coveralls are worn in asbestos work area, treat and dispose of as asbestos contaminated waste. Workers and visitors shall also wear other protective apparel required by Ministry of Labour construction regulations.

1.7.4 Before entering enclosure(s) put on respirator with new or tested filters, clean coveralls and head covers. Wear coveralls with hoods up at all times.

1.7.5 Workers may leave enclosure, only after all disturbance of asbestos-containing materials is complete and enclosure has been cleaned-up. When leaving enclosure workers and visitors use HEPA vacuum to clean exterior of respirator to remove visible contamination, and remove gross contamination from coveralls and other protective equipment. Immediately upon leaving enclosure workers and visitors shall remove coveralls and wash face and hands thoroughly with soap and water; wet clean inside of respirator. Remove filters and dispose of or test filters according to manufacturer's specifications. Place coveralls and used filters in receptacles for disposal with other asbestos contaminated materials. Coveralls can be reused, to maximum of 8 hours wear, if coveralls remain inside work area.

1.7.6 Do not eat, drink, smoke or chew gum or tobacco in enclosures.

1.7.7 Workers and visitors shall be fully protected as specified herein whenever possibility of disturbance of asbestos exists.

2 PART 2 - Products

2.1 MATERIALS

2.1.1 **Polyethylene Sheeting:** 0.15 mm (6 mil) minimum thickness unless otherwise specified; in sheet size to minimize joints.

2.1.2 **Rip-Proof Polyethylene:** 0.20 mm (8 mil) fabric made up from 0.13 mm (5 mil) weave and 2 layers 0.04 mm (1.5 mil) poly laminate, in sheet size to minimize joints.

2.1.3 **Tape:** Tape suitable for sealing polyethylene to surface encountered under both wet conditions using amended water, and dry conditions.

2.1.4 **Wetting Agent:** Non-sudsing surface active agent; mixed with water in concentration to provide thorough wetting of asbestos fibre: Asbestos-Wet, distributed by Asbetec Distributors, Richmond Hill, Ontario.

2.1.5 **Amended Water:** Water with wetting agent added.

2.1.6 **Asbestos Waste Receptors:** 2 separate containers of which 1 shall consist of 0.15 mm (6 mil) minimum thickness polyethylene bag. Other container may be 0.15 mm (6 mil) minimum thickness polyethylene bag or rigid sealable container such as metal or cardboard, fibre drum or wood box. Other container shall be adequate to prevent perforating rips, or tears in first container during filling, transport or disposal. Containers must be acceptable to disposal Site selected and Ministry of Environment and Energy.

2.1.7 **Sealer:** Sealer for purpose of trapping residual fibre debris. Product must have flame spread and smoke development ratings both less than 25. Product shall leave no stain when dry: TC-55 (clear), A/D Fire Protection Systems Inc., Scarborough, Ontario. For mechanical equipment, pipes, boilers, etc. use high temperature sealer only: Chil-Abate CP210, Childers Products Company, Mississauga, Ontario.

2.1.8 **Sprayer:** Garden-type portable manual sprayer, low velocity, capable of producing mist or fine spray.

2.1.9 **HEPA Vacuum:** Vacuum with all necessary fittings, tools and attachments. Air must pass HEPA filter before discharge.

3 PART 3 - Execution

3.1 FULL-ENCLOSURE ASBESTOS WORK AREAS

3.1.1 Move equipment, tools, and stored materials which can be moved without disturbing asbestos-containing materials.

3.1.2 Remove elements which can be removed without disturbing friable asbestos material.

3.1.3 If working from within building, request building personnel to shut off air handling and ventilation systems supplying or exhausting from asbestos work area enclosure(s). Ensure air-handling systems remain shut off for duration of work.

3.1.4 Erect wood or metal framing between asbestos work area and remaining building area, as necessary to support polyethylene sheeting enclosures. Free standing enclosure shall have completely sealed polyethylene top.

3.1.5 Use sufficient layers to provide adequate protection. Protect floors with at least 1 layer of polyethylene sheeting. Where walls are protected with sheeting, cover floors first so that wall polyethylene overlaps floor layer by at least 300 mm (12").

3.1.6 Where applicable clean previously contaminated surfaces with HEPA vacuum before covering with sheeting.

3.1.7 If enclosure is used for more than 1 shift, construct airlock for entry to and exit from enclosure. Clean enclosure prior to exiting at completion of each shift.

3.1.8 Establish negative pressure in asbestos work area. Operate negative pressure units or HEPA vacuums continuously from this time until completion of contaminated work.

3.1.9 Provide soap, water and towels for washing of worker's face and hands when exiting enclosure.

3.1.10 Maintain emergency and fire exits from asbestos work area, or establish alternative exits satisfactory to authorities having jurisdiction.

3.1.11 Ensure existing power supply to asbestos work area is isolated and disconnected where necessary. Do not disrupt power supply to remainder of building.

3.2 MAINTENANCE OF ENCLOSURES

3.2.1 Maintain enclosures in tidy condition.

3.2.2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

3.2.3 Visually inspect enclosures at beginning of each working period.

3.3 COMMENCE ASBESTOS REMOVAL OR CLEANUP WORK WHEN

3.3.1 Arrangements have been made for disposal of waste.

3.3.2 Asbestos work areas enclosures and parts of building required to remain in use are effectively segregated. Negative pressure equipment is operating continuously.

3.3.3 Tools, equipment and materials waste receptors are inside enclosure.

3.3.4 Arrangements have been made for work area security.

3.3.5 Signs are displayed in all areas where access to sealed asbestos work areas possible. Signs shall read:

CAUTION
Asbestos Hazard Area
No Unauthorized Entry
Wear assigned protective equipment
Breathing asbestos dust may cause serious bodily harm.

3.3.6 Owner's Consultant has been notified of intention to proceed and has reviewed enclosures and equipment.

3.4 REMOVAL OF VINYL ASBESTOS TILE AND MASTIC

3.4.1 Before commencing work, prepare Site as described in articles 3.1, 3.2 and 3.3.

3.4.2 Seal opening to enclosure with tape after entry of worker. Worker shall remain inside enclosure until disturbed asbestos-containing materials are removed and enclosure has been effectively cleaned.

3.4.3 Perform work required inside enclosure.

3.4.4 Start removal by wedging heavy-duty scraper in seam of 2 adjoining tiles and gradually forcing edge of 1 tile up and away from floor. Do not break off pieces of tile, but continue to force balance of tile up.

3.4.5 When first tile is removed, place it, without breaking into smaller pieces, into asbestos waste receptor.

3.4.6 Continue removal of tiles using hand tools and removing tiles intact wherever possible.

When adhesive is spread heavily or is quite hard, it may prove easier to force scraper through tightly adhered areas by striking scraper handle with hammer using blows of moderate force while maintaining scraper at 25^{o} to 30^{o} angle to floor. When even this technique cannot loosen tile, removal can be simplified by heating tile with hot air gun or infrared heaters until heat penetrates through tile and softens adhesive. Do not use powered electric scrapers.

3.4.7 After removal of small area scrape up adhesive remaining on floor with hand scraper until only thin smooth film remains by grinding of the remaining mastic from the concrete floor surface. Where deposits are heavy or difficult to grind, hot air gun or infrared heaters may be used. Deposit scrapings into asbestos waste receptors. Do not dry scrape surface of adhering pieces of tile.

3.4.8 On completion of area, clean floor with HEPA vacuum.

3.4.9 Trades personnel may enter enclosure to perform Type II operations under the guidance of competent worker.

3.4.10 When cleaning or removing asbestos-containing drywall walls within enclosure, spray asbestos-containing material with amended water. Saturate asbestos to prevent release of airborne fibres during removal. Place fully saturated asbestos directly into waste containers.

3.4.11 Treat materials removed including used polyethylene sheeting as asbestos contaminated waste and dispose of as such.

3.4.12 Following completion of work, clean surfaces from which asbestos has been disturbed with HEPA vacuum, or wet-sponge if appropriate to remove all visible material.

3.4.13 Carefully place asbestos waste in inner bag of asbestos waste receptor. Clean inner bag surface of gross contamination and place in clean 6 mil outer bag. If waste is likely to tear inner bag, then instead of outer bag use fibre or metal drum, cardboard or wood box, or other suitably sturdy container. After wet-sponging or vacuuming to remove visible asbestos, wet clean entire enclosure. Apply coat of sealer to all surfaces from which asbestos has been disturbed. Apply thinned coat (sufficient to coat all surfaces) to interior of polyethylene enclosure prior to tear down.

3.5 REMOVAL OF ASBESTOS DRYWALL

3.5.1 Before commencing work, prepare Site as described in articles 3.1, 3.2 and 3.3.

3.5.2 Seal opening to enclosure with tape after entry of worker. Worker shall remain inside enclosure until disturbed asbestos-containing materials are removed and enclosure has been effectively cleaned.

3.5.3 Perform work required inside enclosure. Trades personnel may enter enclosure to perform Type II operations under the guidance of competent worker.

3.5.4 When cleaning or removing asbestos-containing drywall walls within enclosure, spray asbestos-containing material with amended water. Saturate asbestos to prevent release of airborne fibres during removal. Place fully saturated asbestos directly into waste containers.

3.5.5 Treat materials removed including used polyethylene sheeting as asbestos

contaminated waste and dispose of as such.

3.5.6 Following completion of work, clean surfaces from which asbestos has been disturbed with HEPA vacuum, or wet-sponge if appropriate to remove all visible material.

3.5.7 Carefully place asbestos waste in inner bag of asbestos waste receptor. Clean inner bag surface of gross contamination and place in clean 6 mil outer bag. If waste is likely to tear inner bag, then instead of outer bag use fibre or metal drum, cardboard or wood box, or other suitably sturdy container.

3.5.8 After wet-sponging or vacuuming to remove visible asbestos, wet clean entire enclosure. Apply coat of sealer to all surfaces from which asbestos has been disturbed. Apply thinned coat (sufficient to coat all surfaces) to interior of polyethylene enclosure prior to tear down.

3.6 CEILING ACCESS

3.6.1 Before commencing work, prepare Site as described in articles 3.1, 3.2 and 3.3.

3.6.2 Seal opening to enclosure with tape after entry of worker. Worker shall remain inside enclosure until disturbed asbestos-containing materials are removed and enclosure has been effectively cleaned.

3.6.3 Perform work required inside enclosure. Trades personnel may enter enclosure to perform Type 2 operations under the guidance of competent worker.

3.6.4 Treat materials removed including used polyethylene sheeting as asbestos contaminated waste and dispose of as such.

3.6.5 Following completion of work, clean surfaces from which asbestos has been disturbed with HEPA vacuum, or wet-sponge if appropriate to remove all visible material.

3.6.6 Carefully place asbestos waste in inner bag of asbestos waste receptor. Clean inner bag surface of gross contamination and place in clean 6 mil outer bag. If waste is likely to tear inner bag, then instead of outer bag use fibre or metal drum, cardboard or wood box, or other suitably sturdy container.

3.6.7 After wet-sponging or vacuuming to remove visible asbestos, wet clean entire enclosure. Apply coat of sealer to all surfaces from which asbestos has been disturbed. Apply thinned coat (sufficient to coat all surfaces) to interior of polyethylene enclosure prior to tear down.

3.7 TEAR DOWN OF PROTECTION

3.7.1 When dismantling enclosure, carefully roll polyethylene toward centre of enclosure. As polyethylene is rolled away, immediately remove any visible debris with HEPA vacuum.

3.7.2 Place polyethylene sheeting seals, tape, cleaning material, coveralls, and other contaminated waste in asbestos waste receptors for transport. Remove any debris fallen behind plastic with HEPA vacuum.

3.7.3 Clean up asbestos waste receptors and equipment used in work, and remove from asbestos work area(s) via drum and equipment decontamination enclosure systems, at appropriate time in sequence. Double bag waste immediately prior to transport from site

to disposal bin.

3.7.4 Final review may be carried out by Owner's Consultant to ensure no dust or debris remains.

3.8 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS

3.8.1 When clean-up is complete reinstall items removed to facilitate asbestos related operation, in their proper positions. Reconstruction and reinstallation shall be by tradesmen qualified in work being reinstalled or reconstructed.

3.8.2 At completion of work make good all damage not identified in pre-removal survey referred to in para. 1.7.1.4.

3.9 AIR MONITORING

3.9.1 Owner's Consultant may arrange for air samples to be taken from commencement of work until completion of cleaning operations, both inside and outside of asbestos work area(s) enclosures in accordance with NIOSH methods.

3.9.2 If air sampling is conducted, results of phase contrast microscopy analysis of the sample(s) must be lower than the criteria of 0.01 fibers/cc.

3.10 INSPECTION

3.10.1 From commencement of work until completion of clean-up operations, Clients Consultant may be present.

3.10.2 If visual inspection indicates that areas outside current asbestos work area enclosures are contaminated these areas are to be cleaned in same manner as that applicable to asbestos work areas, at no cost to Client.

3.10.3 Pay cost to provide re-inspection of work found not to be in accordance with these specifications and requirements of authorities having jurisdiction.

3.11 WASTE TRANSPORT AND DISPOSAL

3.11.1 Conform to requirements of Regulation 347 (as amended), made under Environmental Protection Act for Waste Management, transporting and disposal of hazardous waste.

3.11.2 Obtain Certificate of Approval from Ministry of Environment for waste management disposal system for asbestos.

3.11.3 Check with dump operator to determine type of waste containers acceptable.

3.11.4 Ensure shipment of containers to dump is taken by waste hauler licensed to transport asbestos waste.

3.11.5 Each load requires completion of bill of lading showing type and weight of hazardous waste being transported.

3.11.6 Co-operate with Ministry of Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to Owner.

3.11.7 Ensure dump operator is fully aware of hazardous material being dumped.

END OF SECTION

1 PART 1 - GENERAL

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 **RELATED WORK**

1.2.1 Non-Friable Asbestos Removal: Section 02 13 82, Type 2 Asbestos Removal

1.2.2 Silica Disturbance Procedures: Section 02 13 86

1.2.3 Mercury Removal Procedures: Section 02 13 87

1.3 **SITE CONDITIONS**

1.3.1 Paints containing lead in excess of 0.009% by dry weight are suspected to be present on walls, ceilings, and bulkheads and will be, or potentially will be, disturbed during the course of renovation activities.

1.3.2 Metal sheeting and piping is assumed to contain lead.

1.4 **DESCRIPTION OF WORK**

1.4.1 **Disturbance of Lead Based Building Materials**:

1.4.1.1 Stabilize any loose and flaking paint and HEPA vacuum any paint flake debris encountered prior to initializing demolition activity and on surfaces scheduled to remain that are not part of demolition/renovation activities at University of Toronto Mississauga, 3359 Mississauga Road, Mississauga, Ontario. For information purposes only, refer to Safetech Environmental Limited report titled "Designated Substances and *Hazardous Building Materials Assessment – Project # 2017 18 17* DV ERS/GGR/HCC *Renovation Project*" issued on June 17, 2018 and revised November 26, 2019. A copy of this report can be found within the contract documents.

1.4.1.2 Loose and flaking paint to be removed and all surfaces stabilized to prevent further flaking. This work may be performed using drop sheets and utilizing polyethylene enclosures ensuring that all lead related work is contained to prevent the spread of lead containing particles. Paint flakes may be HEPA vacuumed directly into vacuum or scraped off surfaces using hand scraper. All waste to be bagged and labelled for proper disposal. All lead related work to be conducted in accordance with Type 2a procedures outlined in the Ministry of Labour guideline, "Lead on Construction Projects" dated April 2011.

1.4.2 Remove lead dust, clean and decontaminate all surfaces within work area.

1.4.3 Work area surfaces may be HEPA vacuumed with vacuum cleaner contents collected and disposed of as hazardous waste.

1.4.4 Dispose of all waste as lead contaminated including insulation, polyethylene drop sheets, coveralls, respirator filters, and all porous materials that cannot be properly cleaned and decontaminated.

1.4.5 This sequence to be repeated for each section of work.

1.5 **REFERENCES/REGULATIONS**

1.5.1 Comply with Federal, Provincial and local authority requirements. The more stringent requirements shall apply in the event of a conflict with any particular authority or jurisdiction. Regulations and Guidelines include:

1.5.2 Regulations made under the *Occupational Health and Safety Act*, Revised Statutes of Ontario, 1990, Chapter O.1 as amended.

1.5.3 The Occupational Health and Safety Act, Regulation for Construction Projects, O. Reg. 213/91, amended to O. Reg. 96/11.

1.5.4 The Occupational Health and Safety Act, Regulation Respecting Lead, O. Reg. 490/09.

1.5.5 Ministry of Labour Guideline regarding Lead on Construction Projects, April 2011.

1.5.6 Ministry of Environment, Regulation 347/90 amended to 234/11 for disposal of hazardous waste.

1.6 **DEFINITIONS**

1.6.1 **Authorized Visitor(s):** Owner's Consultant or persons representing regulatory agencies, and person(s) authorized by either of them

1.6.2 **Work Area(s):** Area(s) where work takes place which will, or may disturb lead paint and lead dust.

1.6.3 **HEPA Filter:** High Efficiency Particulate Aerosol filter at least 99.97 percent efficient in collecting 0.3-micrometer aerosol.

1.6.4 **HEPA Vacuum:** High Efficiency Particulate Aerosol filtered vacuum equipment acceptable to local provincial Ministry of Labour, and Health Canada. Ensure vacuums are equipped with hoses, fittings, and nozzle attachments. Maintain vacuum equipment and system properly.

1.6.5 **Polyethylene Sheeting**: Polyethylene sheeting of 0.15 mm (6 mil) minimum thickness with tape seals along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous polyethylene membrane protection.

1.6.6 **Peel Away 1:** Chemical product for removing paints and other adhesives manufactured by Dumond Chemical Inc., 1501 Broadway, New York, NY 10036, or equivalent.

1.6.7 **Work Area**: Polyethylene enclosed portion of work area where disturbance of lead containing paint and generated dust to take place.

1.7 **SUBMITTALS**

1.7.1 Submit names of supervisory personnel who will be responsible for Lead abatement work area(s). One of these supervisors must remain on site at all times while lead paint

disturbance, removal or cleanup is occurring. Submit proof that supervisory personnel have attended training course on lead control and have performed supervisory function on at least 2 other lead removal projects of similar size of this project.

1.7.2 Proof of worker training for lead abatement work.

1.7.3 Proof of worker training for fall arrest and proper use of safety harness assembly and equipment.

1.7.4 Certificates indicating each worker has had proper respirator fit test for the respirator appropriate for work being performed.

1.7.5 Written determination from an occupational physician for each worker stating that the worker is fit to perform lead abatement work and is capable of performing work wearing specified respiratory protection. Each worker should also be enrolled in a lead surveillance program.

1.7.5.1 Submit prior to commencement of work and at completion of project, blood test results for all workers who have had a minimum of 5 days lead exposure on the project. Results must be made available for review by Owner's Consultant.

1.7.6 Submit list of existing damage for acceptance.

1.7.7 Laws of province of Ontario shall govern this work. Contractor shall observe all such laws and shall obtain and/or pay all permits, notices, fees, taxes, and duties as may be required. Likewise, it is the responsibility of contractor to comply with Workplace Safety and Insurance Board (WSIB).

1.7.8 Before commencing any work, Contractor shall submit, in writing, confirmation of good standing with Workplace Safety and Insurance Board (WSIB).

1.7.9 Submit proposed schedule showing phasing and scheduling.

1.7.10 Submit proof satisfactory to Owner's Consultant that suitable arrangements have been made to dispose of lead containing waste in accordance with requirements of authority having jurisdiction.

1.7.11 **Instruction and Training**

1.7.11.1 Before commencing work provide satisfactory proof that every worker has had instruction and training in hazards of lead exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

1.7.11.2 Instruction and training on respirators includes:

- Limitations of equipment,
- Inspection and maintenance of equipment,
- Fitting of equipment, and disinfecting of equipment.

1.7.11.3 The Abatement Contractor to post on the job bulletin board instructions, procedures and information pertaining to abatement work.

1.8 **WORKER AND VISITOR PROTECTION**

1.8.1 **Instructions:** Before entering lead removal work area(s), instruct workers and Authorized Visitor(s) in use of respirators, and all aspects of Work procedures and protective measures. Provide instruction by competent person as defined by The Occupational Health and Safety Act.

1.8.1.1 Provide disposable full body coveralls and approved respiratory protection to authorized visitors.

1.8.2 **Respirators:** Provide workers with personally issued and marked half face air purifying respirators with P100 high efficiency (HEPA) cartridge filters. Provide approved respirators to Authorized Visitor(s). Provide sufficient filters and cartridges so workers can install new filters and cartridges following disposal of used filters and cartridges before re-entering contaminated areas. Respirators shall be acceptable to Occupational Health Branch of Ministry of Labour.

1.8.2.1 The Maximum Use Concentration (MUC) of an APR fitted with P100 filters for all work performed inside removal work area is 0.50 mg/m^3. Should airborne lead concentrations exceed this value, all work must stop and work practices modified to reduce exposure to acceptable levels.

1.8.2.2 Provide instruction in use of respirators, including qualitative fit testing. No worker or Authorized Visitor(s) may have facial hair which prevents proper contact between respirator face-piece and skin. Alternatively, supplied air positive pressure respirator or supplied air positive pressure hood or helmet may be provided. Maintain respirators in proper functioning and clean condition, or remove from Site.

1.8.3 **Protective Clothing:** Workers and Authorized Visitor(s) shall wear disposable full body personal protective apparel including attached head covering. In addition workers are expected to wear nitrile gloves and protective eye goggles as is required by Ministry of Labour construction regulations. Once worn, protective coveralls shall be discarded and disposed of as lead contaminated waste

1.8.4 Do not eat, drink, smoke or chew gum or tobacco in lead removal work area.

1.8.5 Workers and Authorized Visitors shall wash hands and face when leaving lead removal work area. Contractor to provide workers with a designated washroom facility.

1.9 **PRODUCTS**

1.10 **Polyethylene:** 0.15 mm (6 mil) minimum thickness unless otherwise specified; in sheet size to minimize joints.

1.11 **Rip-Proof Polyethylene:** 0.20 mm (8 mil) fabric made up from 0.13 mm (5 mil weave and 2 layers 0.04 mm (1.5 mil) poly laminate, in sheet size to minimize joints.

1.12 **Tape:** Tape suitable for sealing polyethylene to surface encountered, under both wet conditions using amended water, and dry conditions.

1.13 **Waste Receptors:** Two separate containers of which 1 shall consist of 0.15 mm (6 mil) minimum thickness sealable polyethylene bag. Other container may be 0.15 mm (6 mil) minimum thickness polyethylene bag. Other container shall be adequate to prevent

perforating rips, or tears during filling, transport or disposal. Containers must be acceptable to disposal site selected, and Ministry of Environment.

1.14 **Sprayer:** Garden type, portable manual sprayer, low velocity, capable of producing fine spray.

1.15 **Ground Fault Panel:** Portable electrical panel equipped with ground fault circuit interrupters (5 mA protection) of sufficient capacity to power all electrical equipment and lights in Lead work enclosure. Panel complete with ground fault interrupter lights, test switch to ensure unit is working, and reset switch. Installed by licensed electrician.

1.16 **HEPA Vacuum:** Vacuum with all necessary fittings, tools and attachments. Air must pass HEPA filter before discharge.

1.17 **Protective Coveralls:** Disposable full body coveralls complete with elasticized hoods made of spun polyolefin material Tyvek by Dupont or nonwoven material Kleenguard by Kimberley Clark.

1.18 **Power Sprayer:** Graco Maxi-wetter or equivalent, from Hazmasters Environmental, Pickering, Ontario.

3 **Execution**

3.1 PREPARATION

3.1.1 Full-Enclosure Lead Work Area(s)

3.1.2 Seal off openings such as doorways, windows, vents, service holes in walls and grilles to non-operating ducts with polyethylene sheeting sealed with tape or with polyurethane foam as appropriate.

3.1.3 Polyethylene enclosure that is impermeable to dust that is supported and secured by structure with sealed joints, and entrances to work area equipped with overlapping tarps as air locks. Existing polyethylene enclosures to be utilized.

3.1.4 Request building personnel to shut off air handling and ventilation systems supplying or exhausting from asbestos work area enclosure(s). Ensure air-handling systems remain shut off for duration of work.

3.1.5 Maintain emergency and fire exits from Lead work area, or establish alternative exits satisfactory to authorities having jurisdiction.

3.1.6 Ensure existing power supply to Lead work area is isolated and disconnected where necessary. Do not disrupt power supply to remaining areas of building. Provide ground fault electrical system when necessary. Supply all electrical apparatus from this ground fault system. Ensure safe installation of electrical lines and equipment.

3.1.7 Provide temporary lighting in Lead work area to levels that will permit work to be done safely and well.

3.1.8 Establish negative pressure in lead work area. Operate negative pressure units or HEPA vacuums continuously from this time until completion of contaminated work.

3.1.9 Provide fire extinguisher at each emergency exit, and in decontamination facilities. Protect extinguishers with polyethylene sheeting in manner that will not hamper emergency use.

3.1.10 Provide soap, water and towels for washing of worker's face and hands when exiting enclosure.

3.2 **WORKERS' DECONTAMINATION**

3.2.1 Construct workers' decontamination system at entrance to lead work area. Worker decontamination enclosure system shall comprise two rooms as follows:

3.2.1.1 Provide a set of curtain doorways between each room, and at both dirty and clean entrances to enclosure systems.

3.2.1.2 **Dirty Change Room**: Build room at entrance to lead work area. Install waste receptor, and storage facilities for worker's shoes and any protective clothing to be re-worn in lead work areas. Equipment and access room shall be large enough to accommodate specified facilities, and other equipment needed, and at least one worker allowing sufficient space to undress comfortably. Provide washing facilities in equipment room.

3.2.1.3 **Clean Room**: Build room between dirty room and clean areas outside of enclosures. At doorway to clean room, provide vented wood door, with locking passage set. Provide hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install water heater, if required.

3.3 **MAINTENANCE OF ENCLOSURES**

3.3.1 Maintain enclosures in tidy condition.

3.3.2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

3.3.3 Visually inspect enclosures at beginning and end of each working period.

3.4 **DO NOT COMMENCE LEAD ABATEMENT WORK UNTIL**

3.4.1 Arrangements have been made for disposal of waste.

3.4.2 Lead work area and decontamination enclosure is effectively segregated. Negative pressure equipment is operating continuously.

3.4.3 Tools, equipment and materials waste receptors are on hand.

3.4.4 Arrangements have been made with Owner's Consultant for work area security.

3.4.5 Signs are displayed in areas where access to sealed Lead work area is possible. Signs shall read:

CAUTION
Lead Hazard Area
No Unauthorized Entry

Wear assigned protective equipment
Breathing Lead dust may cause serious bodily harm.

3.4.6 Owner's Consultant has been notified of intention to proceed and has reviewed enclosures, equipment and procedures.

3.5 **CONTAMINATED PREPARATION FOR FULL-ENCLOSURE LEAD WORK AREA**

3.5.1 Before performing any contaminated work, prepare site as described in articles 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6.

3.5.2 Promptly seal holes or penetrations in structure to provide air tight enclosure around Lead work area(s).

3.8 **REMOVAL**

3.8.1 Remove lead containing paint using hand methods. Dust and debris to be HEPA vacuumed to remove all lead containing material.

3.8.2 Hand tools may also be used to perform required cutting of lead sheeting and/or pipe.

3.8.3 For areas where lead paint cannot be effectively removed using hand methods, utilize the Peel Away 1 System manufactured by Dumond Chemical Inc. 1501 Broadway, New York, NY 10036 or equivalent.

3.8.4 If HEPA vacuuming, place full vacuum bags into waste receptors. Double polyethylene bags are to be used, inner bag shall be cleaned of gross contamination and placed in a clean 6 mil outer polyethylene bag in container cleaning room immediately prior to transfer from Site.

3.9 **CLEAN-UP**

3.9.1 Clean surfaces from which lead has been removed with brushes and HEPA vacuum or wet-sponge to remove visible dust and debris. HEPA vacuum all surfaces to ensure free of dust and debris.

3.9.2 Remove sealed and labeled lead waste receptors and dispose of to authorized disposal area in accordance with requirements of disposal authority.

3.9.3 After brushing and wet sponging to remove visible lead dust, damp clean entire work area including equipment and access area, polyethylene sheeting and equipment used in process.

3.9.4 Request visual inspection and acceptance. There should be no dust on ducts, scaffold or platform, sills, building surfaces or enclosure, where applicable. Following inspection and acceptance, allow minimum of 2 hours flushing time with no disturbance of work area.

3.10 **TEAR DOWN OF PROTECTION**

3.10.1 Remove polyethylene sheeting exposed during contaminated work including upper surfaces plus any underlying sheeting contaminated by water leaks, rips, tears, or exposed by failure of upper layer. Wear half face piece respirator and disposable coveralls during removal of

sheeting. Carefully roll sheeting away from walls to center of lead work area. As sheeting is rolled away from walls and corners, HEPA vacuum visible debris.

3.10.2 Place polyethylene sheeting, seals, tape, cleaning material, clothing, and other contaminated waste in Lead waste receptors for transport. Remove any debris fallen behind sheeting with HEPA vacuum.

3.10.3 Clean up lead work area(s), equipment and access area, washing and other enclosures that may have been contaminated during work.

3.10.4 Clean up lead waste receptors and equipment used in work and remove from work area(s) via drum and equipment decontamination enclosure system, at an appropriate time in sequence.

3.10.5 Remove hoardings, temporary lighting, equipment and facilities provided for work.

3.10.6 A final review may be carried out by Owner's Consultant to ensure that no dust or debris remains.

3.10.7 Worker to properly decontaminate him/herself before each break and before going home at completion of work shift. Wash centre to have plenty of soap and hot water, and towels. Instruction to be provided for proper hygiene practices.

3.10.8 Perform work in manner to reduce dust creation to lowest levels practicable. Work is subject to visual inspection and air monitoring. Any contamination of surrounding areas indicated by visual inspection or air monitoring shall require complete enclosure and clean up of affected areas.

3.11 FIELD QUALITY CONTROL

3.11.1 Air Monitoring

3.11.2 Owner's Consultant may arrange for air samples to be taken from commencement of work until completion of cleaning operations in accordance with NIOSH methods. Air samples may be collected both inside the building during abatement activity and inside enclosed abatement work area.

3.11.3 Cooperate with Owner's Consultant in collection of air samples, including requiring workers to wear sampling pumps for up to half shift periods. Workers shall exercise care not to damage sampling equipment.

3.11.4 Air sampling for lead may be performed within occupied areas of building by Owner’s Consultant prior to the commencement of work to establish typical background levels.

3.11.5 During the course of work, additional air samples for lead may be taken periodically inside the building, adjacent to ongoing work. Airborne concentrations of these contaminants are not to significantly exceed the established background levels and at no point should the time-weighted average concentrations exceed $1/10^{th}$ of the Ontario regulated exposure limits for lead ($50\mu g/m^3$).

3.11.6 Should airborne concentrations of lead $1/10^{th}$ of these limits, Abatement Contractor must immediately stop work, determine the source of infiltration and repair the problem.

Abatement Contractor will also be responsible for cleanup of internal locations within the building adjacent to where work was being performed.

3.11.7 In addition to the above limits, indoor air quality guidelines for lead (1.5µg/m^3) would be used as a secondary limit for comparison as provided in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62-2001, "*Ventilation for Acceptable Indoor Air Quality".*

3.12 **INSPECTION**

3.12.1 From commencement of work until completion of clean-up operations, Owner's Consultant may be present periodically; both inside and outside lead removal work area(s).

3.12.2 If lead work area(s) or adjacent areas, are found unacceptable in accordance with standards specified or required by authorities having jurisdiction, correct such deficiencies at no cost to Owner.

3.12.3 Pay cost to provide re-inspection of work found not in accordance with these specifications and requirements of authorities having jurisdiction.

3.12.4 Cooperate with and assist inspection and testing company's personnel during inspection and testing.

3.13 **CLEAN-UP**

3.13.1 Frequently during work and immediately after completion of work, clean up dust and waste containing lead using HEPA vacuum or by damp mopping.

3.13.2 Place dust and waste containing lead in sealed dust-tight waste bags. Treat drop sheets as lead waste. Wet and fold drop sheets to contain dust and then place in waste bags.

3.13.3 Immediately before their removal from work area, and disposal, clean each filled waste bag using damp cloths or HEPA vacuum.

3.13.4 Seal and remove from Site. Dispose of in accordance with requirements of Provincial authority having jurisdiction. Supervise dumping and ensure dump operator is fully aware of hazardous nature of material being dumped and that guidelines and regulations for lead disposal are followed.

3.13.5 Perform final clean up of work areas and adjacent areas affected by work using HEPA vacuum.

3.14 **DISPOSAL**

3.14.1 Conform to requirements of Regulation 347 as amended by 234/11 under Environmental Protection Act for Waste Management, transporting and disposal of hazardous waste.

3.14.2 Dispose of lead waste in accordance with requirements of Provincial and federal authority having jurisdiction.

3.14.3 Cooperate with Ministry of Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to Owner.

3.14.4 Provided Owner's Consultant with original copy of waste shipping manifest for disposed lead containing waste issued by dump operator. Contractor is responsible for completing all required manifest documentation for each load leaving the site.

END OF SECTION

1.0 GENERAL

1.1 General Requirements

1.1.1 Comply with requirements of Division 1.

1.2 Related Work

1.2.1 Non-Friable Asbestos Removal: Section 02 13 82, Type 2 Asbestos Removal

1.2.2 Lead Disturbance Procedures: Section 02 13 85

1.2.3 Mercury Removal Procedures: Section 02 13 87

1.3 Description of Work

1.3.1 Removing/demolishing/disturbance of building materials suspected to contain silica may include concrete, concrete block, mortar, ceiling tiles and gypsum board. All related work to be conducted in accordance with Type 1, Type 2, and/or Type 3 removal operations as outlined in the Ontario Ministry of Labour Guideline – Silica on Construction Projects dated April 2011.

1.3.2 Materials identified to contain Silica can be found within the Safetech Environmental Ltd. report titled "Designated Substances and *Hazardous Building Materials Assessment – Project # 2017-18-17* DV ERS/GGR/HCC *Project Renovation"* issued on June 17, 2018 and November 26, 2019. A copy of this report can be found within the contract documents.

1.3.3 All work may be subject to inspection and/or air sampling (clearance and/or exposure monitoring) inside and outside work areas by Client's Consultant. Any contamination of surrounding areas, indicated by visual inspection or air monitoring, shall necessitate complete clean-up of affected areas.

1.4 Definitions

1.4.1 **Silica**: means crystalline silica in a respirable form. Silica is the primary component of many construction materials. The best-known and most abundant type of crystalline silica is quartz. Other forms of crystalline silica include cristobalite, tridymite and tripoli. Some commonly used construction materials containing silica include: abrasives used for blasting, brick, refractory brick, plaster, concrete, concrete block, cement, mortar, granite, sandstone, quartzite, slate, gunite, mineral deposits, rock and stone, sand, fill dirt, top soil and asphalt containing rock or stone.

1.4.2 **Silica Work Area**: Area where work takes place, which will, or may, disturb silica-containing material.

1.4.3 **Authorized Visitors**: Client's Consultant and/or person(s) representing regulatory agencies, and person(s) authorized by them.

1.4.4 **HEPA Filter**: High Efficiency Particulate Aerosol filter, at least 99.97% efficient in collecting a 0.3 micron aerosol. Each filter should be individually tested and certified to have an efficiency of not less than 99.97 percent when challenged with 0.3 micron dioctylphtalate (DOP)

particles. DOP test must be conducted immediately prior to commencement of work and certificate presented to owner and/or consultant.

1.4.5 **Effective**: implies that the dust collection system should be capable of controlling airborne silica concentration levels to below 0.05 milligrams per cubic metre (mg/m³).

1.4.6 **Competent Person:** A worker who is qualified because of knowledge, training, and experience to perform work, is familiar with relevant acts and regulations that apply to the work, and has knowledge of all potential or actual dangers to health or safety in work.

1.5 Regulations, Guidelines, & Industry Standards

1.5.1 Contractor shall:

1.5.1.1 Comply with Federal, Provincial, and local requirements pertaining to silica, provided that in any case of conflict among these requirements or with these specifications, most stringent requirements shall apply.

1.5.1.2 Carry out measures and procedures prescribed under the Ontario Regulation 490/09, Designated Substance – Silica.

1.5.1.3 Protect health and safety of workers by ensuring compliance with the specific occupational exposure limits (OELs) for silica. The OEL for cristobalite silica is 0.05 mg/m³ of air as an 8-hour daily or 40 hour weekly time-weighted average. The OEL for quartz and tripoli silica is 0.10 mg/m³. Measures and procedures that ensure construction workers receive the same standard of protection as workers covered by O. Reg. 490 should be implemented on construction projects where exposure to silica is a hazard. Such measures and procedures are deemed to be in compliance with section 25(2) (h) of the OHSA, as taking “every precaution reasonable in the circumstances for the protection of a worker.

1.5.1.4 Carry out measures and procedures prescribed under the Ontario Regulation 213/91, as amended by Ontario Regulation 628/05 – Regulation for Construction Projects; Ontario Regulation 860/90 – Workplace Hazardous Materials Information System (WHMIS); and Ontario Ministry of Labour Guideline – Silica on Construction Projects dated April 2011.

1.5.1.5 Comply with Ontario Environmental Protection Act Regulation 347/90, as amended by O. Reg. 234/11 - General-Waste Management.

1.5.1.6 Ensure every employee and every worker on project complies with applicable acts and regulations.

1.5.1.7 Provide instruction and training by a competent person to every worker in the following subjects: WHMIS training, hazards of silica exposure, recognition of typical operations containing silica, personal hygiene, the use, cleaning and disposal of respirators and personal protective equipment.

1.5.1.8 Protect health and safety of workers and public.

1.5.2 Contractor may:

1.5.2.1 Be requested to provide information on their health and safety record.

1.5.2.2 Be required to provide a copy of their respiratory protection program.

1.5.2.3 Be requested to provide periodic medical examinations for all workers who may be exposed to respirable crystalline silica.

1.6 Internal Policies & Procedures

1.6.1 Ensure that internal policies and procedures of the clients are complied with including, but not limited to the following:

1.6.1.1 All contractors/consultants will not enter designated areas unless trained and appropriately garmented, including appropriate medical clearance which may include medical monitoring and immunization.

1.6.1.2 Have a competent supervisor onsite at all times to supervise work of their employees/subcontractors for large projects.

1.6.1.3 Provide sufficient number of workers trained in first aid on large projects.

1.6.1.4 Do not modify, shut down, open, tap into or alter facilities systems without permission.

1.7 Quality Assurance

1.7.1 Ensure work proceeds on schedule, and meets all requirements of this Section.

1.7.2 Pay cost to Client for inspection performed as a result of failure to perform work satisfactorily regarding quality, safety, or schedule.

1.7.3 Use only skilled and qualified workers for all the trades required for this work.

1.8 Submittals

1.8.1 Before commencing work:

1.8.1.1 Laws of the province of Ontario shall govern this work. Contractor shall observe all such laws and shall obtain and/or pay all permits, notices, fees, taxes, duties as may be required.

1.8.1.2 Submit names of supervisor personnel who will be responsible for silica work area(s).

1.8.1.3 Contractor shall submit, in writing, confirmation of good standing with Workplace Safety and Insurance Board and transcription of insurance.

1.8.1.4 Submit documentation including test results for fire and flammable data and Material Safety Data Sheets for materials and chemicals to be used.

1.9 Worker and Visitor Protection

1.9.1 **Instruction and Training:** Before commencing work, provide to owner and/or consultant satisfactory proof that every worker has had instruction and training in WHMIS; hazards of silica exposure, including health effects and symptom recognition; personal hygiene; respirator requirements; work measures and procedures; and use, cleaning and disposal of

respirators and protective equipment by a competent person as defined by Occupational Health and Safety Act.

1.9.2 **Respirators:** NIOSH-approved respirators may be worn during silica removal activities as per Ontario Regulation 490/09. Silica dust on personal respirators should be removed by damp wiping or HEPA vacuuming. Respirators should be selected in accordance with the NIOSH assigned protection factors. A summary of respirator requirements based on anticipated concentration of airborne silica can be found in Table 1. Maintenance and care for respirators should be conducted as per Canadian Standards Association Z94.4-02 Selection, Use, and Care of Respirators Guideline. If Contractor can demonstrate that the silica exposure levels are below the OEL, respirators may not be required.

Table 1: Respirator Requirements

Silica Removal Operations	Required Respirator
Type 1 Silica Removal Operations (> 0.05 to 0.50 mg/m3 of silica in the form of cristobalite and tridymite) (> 0.10 to 1.0 mg/m3 of silica in the form of quartz and tripoli) • The drilling of holes in concrete or rock that is not part of a tunneling operation or road construction. • Milling of asphalt from concrete highway pavement. • Charging mixers and hoppers with silica sand (sand consisting of at least 95% silica) or silica flour (finely ground sand consisting of at least 95% silica) • Any other operation at a project that requires the handling of silica-containing material in a way that may result in a worker being exposed to airborne silica. • Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling. • Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.	**NIOSH APF = 10** • Half-mask particulate respirator with N-, R-, or P-series filter and 95, 99, or 100 percent efficiency.
Type 2 Silica Removal Operations (> 0.50 to 2.5 mg/m3 of silica in the form of cristobalite and tridymite) (> 1.0 to 5.0 mg/m3 of silica in the form of quartz and tripoli) • Removal of silica containing refractory materials with a jackhammer. • The drilling of holes in concrete or rock that is part of a tunneling operation or road construction. • The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials. • The use of a power tool to remove silica-containing materials. • The use of a power tool indoors to chip or break and remove concrete, masonry, stone, terrazzo or refractory materials. • Tunneling (operation of the tunnel boring machine, tunnel drilling, or tunnel mesh installation). • Tuckpointing and surface grinding. • Dry method dust clean-up from abrasive blasting operations. • Dry mortar removal with an electric or pneumatic cutting device. • The use of compressed air outdoors for removing silica dust. • Entry into area where abrasive blasting is being carried out for more than 15 minutes.	**NIOSH APF = 50** • Full-facepiece air-purifying respirator with any 100-series particulate filter. • Tight-fitting powered air-purifying respirator with any 100-series particulate filter. • Full-facepiece supplied-air respirator operated in demand mode. • Half-mask or full-facepiece supplied air respirator operated in continuous-flow mode.

Silica Removal Operations	Required Respirator
Type 3 Silica Removal Operations (> 2.5 mg/m3 of silica in the form of cristobalite and tridymite) (> 5.0 mg/m3 of silica in the form of quartz and tripoli) • Abrasive blasting with an abrasive that contains ≥ 1% silica. • Abrasive blasting of a material that contains ≥ 1% silica.	**NIOSH APF ≥ 1000** • Type CE abrasive-blast supplied air respirator operated in a positive pressure mode with a tight-fitting half-mask facepiece. • Type CE abrasive-blast supplied air respirator operated in a pressure demand or positive pressure mode with a tight-fitting facepiece.

1.9.3 **Protective Clothing:** Provide workers and visitors in silica work area(s) with disposable and/or washable work clothes, including shoe covers. Work clothes that are contaminated with silica dust should not be worn outside the work area(s). Silica dust on washable work clothes should be removed by damp wiping or HEPA vacuuming and washed in facilities suitable for handling silica contaminated laundry before reusing. Provide or have access to appropriate washing facility equipped with clean water, soap, and individual towels for washing hands and face of workers. The washing facility shall be used by every worker when leaving silica work area(s) and if feasible, the washing facility should include a shower.

1.9.4 Workers who may be exposed to silica on a regular basis should undergo a pre-placement medical assessment and periodic medical examinations.

1.9.5 A worker shall not eat, drink, chew gum, or use tobacco products in work area(s).

2.0 PRODUCTS

2.1 Materials

2.1.1 **HEPA Vacuum:** High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

2.1.2 **Polyethylene sheeting sealed with tape**: Polyethylene sheeting of type and thickness specified sealed with tape along all edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealants, and to prevent escape of silica dust through sheeting into a clean area.

2.1.3 **Tape**: Tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

3.0 EXECUTION

3.1 Preparation

3.1.1 Equipment, tools, furnishings, and stored materials which can be moved, without disturbing silica-containing materials have been moved by Contractor.

3.1.2 Seal all opening or voids in work area(s), such as vents, service holes in walls and air handling ducts as appropriate with plugs and/or tape and/or caulking and/or polyethylene sheeting sealed with tape.

3.1.3 Building personnel have shut off air handling and ventilation systems (if applicable) supplying or exhausting from silica work area(s)/enclosure(s). Ensure air handling systems remain shut off during duration of work.

3.1.4 Before disturbing silica-containing material, install polyethylene drop sheets as appropriate to control spread of dust.

3.1.5 Establish ropes, barriers and/or partial enclosures in order to prevent unauthorized personnel from entering work area(s).

3.1.6 If significant concentrations of dust are being generated the work should be re-evaulated by a qualified person and additional procedures should be implemented such as: a full enclosure should be erected using polyethylene sheeting (or in the event that the sheeting needs support, wood framing may also be used) in order to separate silica work area(s) from remaining building areas. The Ontario Ministry of Labour Guideline – Silica on Construction Projects dated April 2011 should be consulted for all additional recommended requirements.

3.1.7 Emergency and fire exits are established from silica work area(s), or alternative exits have been established satisfactory to authorities having jurisdiction.

3.1.8 Temporary lighting in silica work area(s) has been provided (if necessary) to level that will permit work to be done safely and well where necessary.

3.1.9 Signs are displayed in all areas where access to silica work area(s) is possible. Signs should be at least 500 mm x 350 mm and state the date and place of the silica removal project. Such signs shall read in large, clearly visible letters:

CAUTION
Silica Dust Hazard
No Unauthorized Entry
Wear Assigned Personal Protective Equipment

3.1.10 Arrangements have been made with Client for work area security.

3.1.11 Client's Consultant has been notified of intention to proceed and has reviewed equipment and procedures.

2 Removal

3.2.1 Seal opening to polyethylene enclosure with tape or ensure appropriate barriers are in place after entry of worker(s).

3.2.2 Perform work required within silica enclosure(s)/work area(s) using appropriate dust control measures, including a mechanical ventilation system and/or wetting, and/or the use of a dust collection system if practical. Compressed air or dry sweeping should be avoided.

3.2.3 The work area(s) should be thoroughly wetted prior to and/or during all silica removal operations.

3.2.4 Continuous cleaning during removal work operations should be conducted to control the spread of silica dust.

3.3 Clean-Up

3.3.2 Clean all surfaces by washing down with water and vacuuming with a HEPA vacuum until no visible residue remains to prevent dust-containing silica from spreading.

3.3.3 Workers exposed to silica should be provided with or have access to washing facilities equipped with clean water, soap, and individual towels.

3.3.4 Silica dust on personal protective clothing and equipment should be removed by damp wiping or HEPA vacuuming.

3.3.5 When exiting the enclosure(s)/area(s), dispose of contaminated disposable work clothes as construction waste.

3.3.6 All workers and visitors in the silica work area(s) must properly decontaminate themselves prior to leaving the work area.

3.4 Air Monitoring

3.4.1 If air monitoring is conducted to determine the concentrations of airborne silica, Client's Consultant shall arrange for air samples to be taken as required inside of silica work area(s) and/or enclosure(s). These air sampling results can then be used to determine if the engineering controls implemented (Type 1, 2, or 3) are providing adequate protection for workers.

3.5 Re-Establishment of Objects and Systems

3.5.1 Reconstruct items demolished (if required) which are to remain and reinstall objects and items in their proper positions which were removed to facilitate silica removal operations. Reconstruction and reinstallation shall be done by tradesmen qualified in work being reinstalled or reconstructed. 3.5.2 Re-establish mechanical and electrical systems (if required) to remain operative in proper working order. Arrange for, and pay costs of, electrical or mechanical repairs needed due to this work.

3.6 Inspection

3.6.1 From commencement of work until completion of clean-up operations, Client's Consultant may be present on an as required basis, both inside and outside silica work area(s).

3.6.2 Pay cost to provide re-inspection of work found not in accordance with these specifications and requirements of authorities having jurisdiction.

3.7 Disposal of Waste

3.7.1 Conform to requirements of Ontario Environmental Protection Act Regulation 347/90, as amended by O. Reg. 234/11 – General Waste Management.

End of Section

1.0 GENERAL

1.1 General Requirements

1.1.1 Comply with requirements of Division 1.

1.2 Related Work

1.2.1 Non-Friable Asbestos Removal: Section 02 13 82, Type 2 Asbestos Removal

1.2.2 Lead Disturbance Procedures: Section 02 13 85

1.2.3 Silica Disturbance Procedures: Section 02 13 86

1.3 Description of Work

1.3.1 Remove, package and recycle/dispose of all mercury vapour containing fluorescent light tubes that are located throughout project areas of Project # 2017-18-17 on the 1st Floor of the South Building (William Davis Building) at the University of Toronto Mississauga located at 3359 Mississauga Road, Mississauga, Ontario.

1.3.2 Mercury-containing components identified can be found within Safetech Environmental Limited report titled "*Hazardous Building Materials Assessment – UTM Project # 2017-18-17,* DV ERS/GGR/HCC *Renovation Project"* issued on June 17, 2018 and revised November 26, 2019. A copy of this report can be found within the contract documents. Locations of mercury tubes area as follows:

1.3.3 All work may be subject to inspection by Client's Consultant.

1.4 Regulations

1.4.1 Comply with Federal, Provincial and local requirements, provided that in any case of conflict among those requirements or with these Specifications more stringent requirements shall apply. Work shall be performed under regulations in effect at time work is performed. Regulations include but are not limited to the following:

1.4.1.1 Environmental Protection Act, Revised Statutes of Ontario 1990, Chapter E. 19.

1.4.1.2 Canadian Environmental Protection Act, Revised Statutes of Canada 1985, c.16.

1.4.1.3 Ministry of Environment Regulations for the disposal of mercury waste, including R.R.O. 1990, Regulation 347/90 as amended by O. Reg. 234/11.

1.4.1.4 Ontario Regulation 490/09 respecting Mercury.

1.5 Instruction and Training

1.5.1 Ensure that all workers likely to handle mercury-containing items are trained in use of Mercury Spill Kit and are trained in handling of mercury.

2.0 PRODUCTS

2.1 Materials

2.1.1 **Cardboard Containers**: New or used cardboard boxes. Suitable for packaging of fluorescent light tubes to prevent breakage of tubes.

2.2 Equipment

2.2.1 **Mercury Spill Response Kit** consisting of following:

2.2.1.1 HEPA vacuum dedicated for use with mercury spills

2.2.1.2 Air-purifying cartridge respirators with mercury absorbing cartridges and an end-of-life service indicator

2.2.1.3 Surgical gloves to prevent skin exposure when handling droplets of mercury

2.2.1.4 Neutralizing compound such as 20% calcium polysulfide or 20% sodium thiosulfide to clean spilled surfaces

3.0 EXECUTION

3.1 Packaging of Fluorescent Light Tubes

3.1.1 Carefully remove fluorescent light tubes from fixtures wipe with a damp cloth or clean with a HEPA filtered vacuum and place in cardboard containers.

3.1.2 Place tubes in container as they are removed from fixtures. Ensure that tubes are packaged in a manner to prevent breakage.

3.1.2 Avoid rough handling of tubes to avoid breakage.

3.1.3 Store full containers in a central location on site.

3.2 Disposal

3.3.1 Do not dispose of fluorescent light tubes containing mercury with other construction waste or in a landfill.

3.3.2 Dispose of mercury containing equipment at a recycling facility approved by Consultant. Recycling company must have the following minimum requirements:

3.3.2.1 Offer complete recycling of all parts (i.e., lamps, caps, clips etc.)

3.3.2.2 Must be able to supply contractor with packaging material, if necessary

End of Section

1.0 GENERAL

1.1 Work Included

.1 Provide all labour, material, equipment, and supervision required to remove and dispose of all material and debris resulting from trenching of the existing slab on grade and removal of the existing backfill material.

2.0 PRODUCTS

Not applicable.

3.0 EXECUTION

3.1 Inspection

.1 Visit and examine the site and note all characteristics and features affecting the Work of this Section.

.2 Properly identify all services, whether buried, built-in, or exposed, as to position, type of service, size, and direction of flow.

.3 Scan and identify location of all existing below grade utilities prior to undertaking any demolition and/or excavation work.

.4 Inspect materials, equipment, and components to be re-used or turned over to the Owner. Note their condition and advise the Consultant in writing of any defects or conditions that would affect their removal and re-use.

3.2 Preparation

.1 Prevent movement, settlement, or damage of elements of existing building that are to remain. Provide bracing, shoring, and supports as required. Protect existing surfaces not to be restored from damage during removal procedures.

.2 Cut and/or cap existing services within the work area, if any, prior to start of Work as required, but do not affect services of areas not under construction or essential to on-going operation of the building.

.3 In all cases, exercise reasonable care during removal operations to avoid damaging items to be salvaged, re-used, or items that are not part of the Work.

.4 Seal off work areas to prevent dust and debris from affecting other areas outside of work area. Prevent public access to areas being repaired.

.5 Tape and/or seal and provide protection to all mechanical and electrical services and all fire alarm and security devices still functioning adjacent to work areas to prevent damage resulting from dust, water, or impact.

.6 Cover drains as required to prevent any construction-related materials and debris from entering the drains. Ensure that all drains continue to operate as required during construction.

.7 Remove or protect in place all surface-mounted or permanent fixtures not to be demolished from damage during demolition procedure.

.8 Apply filter cloth to all exhaust and ventilation vents within work area to prevent dust generated by construction activity from escaping.

.1 Clean or replace filter cloth if filter cloth becomes unsuitably dirty as determined by Consultant.

3.3 Demolition

.1 Remove and dispose of material and debris resulting from removal of the existing concrete slab on grade and backfill material as shown on the Drawings.

.2 Demolition procedures and equipment shall meet all applicable noise control by-laws and regulations at the Place of the Work.

.3 Provide shoring to support slab when removals reduce its load-carrying capacity, as directed by Consultant. No payment will be made for such shoring, as it is to be included in costs of repair as outlined in these documents.

.4 Take care not to damage the surface of sound material that is to remain through removal operation. Where any such damage is done, it is to be repaired by Contractor at their own expense to Consultant’s approval.

.5 Where new concrete is to be applied to existing concrete, leave surface clean and sound.

.6 All required re-painting due to damage overspray, etc. is Contractor’s responsibility.

.7 At end of each day's work, leave work in safe condition so that no part is in danger of causing injury or damage.

3.4 Cutting and Remedial Work

.1 Perform cutting and remedial work required to make affected parts of the Work come together properly and complete the Work.

.2 Coordinate and perform the Work so that cutting and remedial work is kept to a minimum.

.3 Perform cutting by methods to avoid damage to other work.

.4 Provide proper surfaces to receive patching, remedial work, and finishing.

.5 Cutting and remedial work shall be performed by competent and qualified specialists familiar with the Products affected and in a manner that neither damages nor endangers the Work.

.6 Ensure that cutting and remedial work does not jeopardize manufacturers' warranties.

3.5 Waste Disposal

.1 Dispose of waste products and material in strict accordance with product manufacturer's material safety data sheets and governing waste control regulations.

.2 Existing drainage system is not to be used to dispose of project wastes and/or materials.

.3 Store volatile wastes or material in covered metal containers. Remove wastes that create hazardous conditions from premises daily.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Demolition and removal of selected non-structural portions of building.

.2 Salvage:

.1 Salvaging of designated items for reuse by *Owner*.

.2 Salvage of designated items to be reused or recycled.

.3 Removal of surplus materials from the *Place of the Work*.

.4 Related mechanical and electrical work and demolition requirements are covered under Divisions 21, 22, and 23 and Divisions 26, 27, and 28 respectively.

.2 Section excludes:

.1 Demolition, removal, remediation, or abatement of designated substances or materials and toxic and hazardous substances. Refer to Sections 02 13 81, 02 13 85, 02 13 86, and 02 13 87.

.2 Selective exterior demolition. Refer to Section 02 41 13.

1.2 Administrative Requirements

.1 Pre-demolition meeting:

.1 Schedule a pre-demolition meeting following the procedures specified for pre-installation meetings in accordance with Section 01 31 20.

.2 Review existing conditions at the *Place of the Work* thoroughly to establish full extent of items to be removed and items to remain. Commencement of demolition work will be considered to be acceptance of existing conditions at the *Place of the Work* and removal of such items.

.3 Examine adjacent properties to determine extent of protection required.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Demolition report:

.1 Prior to commencement of the work of this section at the *Place of the Work*, prepare and submit to the municipal building department having jurisdiction over the *Place of the Work* a report on the proposed demolition methods and procedures for the removal of indicated structures for the safe retention of structures to remain.

.2 Prepare report under the supervision, and bear the seal and signature, of a professional engineer licensed to practice engineering in the *Place of the Work*, experienced in this type of engineering, and in accordance with Section 01 33 00.

.3 Submit a PDF of the demolition report to the *Consultant* for record purposes only: *Consultant* shall neither review nor accept any liability for the contents of the report.

.4 Without limiting the requirements of authorities having jurisdiction, the demolition report shall include:

.1 Drawings, diagrams and details showing sequence of demolition work and supporting structures.

.2 Description, in detail, of the methods and procedures for working at the base of existing buildings to remain.

.3 Schedule of demolition activities indicating the following:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

.2 Interruption of utility services.

.3 Coordination for shutoff, capping, and continuation of utility services.

.4 Location of temporary street barricades, building interior partitions and means of egress.

.4 Written description of methods for removal and temporary bracing of structural members or supporting construction.

.3 Special procedures submittals:

.1 Existing conditions documentation:

.1 Document existing conditions of adjoining construction and site improvements, including pre-existing damage to finish surfaces that might be misconstrued as damage caused by demolition operations.

.2 Comply with Section 01 32 33.

.3 Submit existing conditions documentation before demolition work begins.

.2 Inventory of items to be salvaged:

.1 Prepare typed inventory of units to be salvaged and cross-reference to drawing showing existing elevations.

.2 Submit inventory following procedures for submittal of shop drawings in accordance with Section 01 33 00.

1.4 Quality Assurance

.1 Qualifications:

.1 *Subcontractor*:

.1 Shall have 5 years' specialized demolition experience, minimum.

.2 Shall be able to deploy adequate equipment and skilled personnel to complete work expediently in an efficient and orderly manner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that utilities have been disconnected and capped.

.2 Observe existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

.3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

.4 When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to *Consultant*.

.5 Survey of existing conditions: Record existing conditions by use of photographs in accordance with Section 01 32 33.

3.2 Utility Services and Mechanical / Electrical Systems

.1 Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28 respectively.

3.3 Selective Demolition, General

.1 Demolish and remove existing construction only to the extent required by new construction, and as otherwise indicated. Use methods required to complete the work within limitations of governing regulations and as follows:

.1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

.2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain 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 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

.4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

.5 Maintain adequate ventilation when using cutting torches.

.6 Remove decayed, infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

.7 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

.8 Dispose of demolished items and materials promptly.

.2 Dispose of demolished materials from *Project* site except where noted otherwise and in accordance with authorities having jurisdiction. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

.3 Do not sell demolished material at the *Place of the Project*.

.4 Clean existing surfaces specified to receive new applied finishes to assure proper adherence.

3.4 Salvage

.1 Remove and store items indicated or directed for salvage. Remove, handle and transport such items to storage area designated in the *Contract Documents*, to an area within the *Place of the Work* designated by *Consultant*, or to an area away from the *Place of the Work* as directed by the *Consultant*. Perform such work to prevent damage to the items during removal and in storage.

.2 The *Owner* shall review *Place of the Work* prior to commencement of demolition and instruct the *Contractor* of the items to be retained for re-use or be turned over to the *Owner*.

.3 Remove and store indicated items for future use by *Owner*. Remove, handle and transport such items to storage area indicated in the *Contract Documents* or to an area within the *Place of the Work* designated by *Consultant*. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage.

3.5 Protection

.1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing building to remain. Make good damage caused by demolition.

.2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify demolition engineer, *Contractor* and *Consultant*.

.3 Prevent debris from obstructing active services and drainage systems.

.4 Protect work to remain against damage. Repair or replace damaged work at no additional cost to the *Owner*.

.5 Slopes of excavated areas after removal of footings shall be left in a stable condition and as required by authorities having jurisdiction.

END OF SECTION

1.0 GENERAL

1.1 Work Included

.1 Provide all labour, materials, equipment, and supervision necessary to prepare slab on grade repair areas and place new concrete repair material as outlined in this Section.

1.2 References

.1 All referenced Standards are latest editions referenced by the Building Code in the Place of the Work, or latest editions if not reference by Code.

.2 Ontario Building Code

.3	CSA A23.1/CSA A23.2	Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
.4	CSA A3000	Cementitious Materials Compendium
.5	CSA S413	Parking Structures
.6	ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
.7	ICRI 310.2R	Selecting and Specifying Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

1.3 Performance Requirements

.1 Concrete repair surfaces shall not scale or crack excessively.

.2 Concrete repair materials shall not spall or debond from existing concrete.

1.4 Submittals

.1 Submit all mix designs, product specifications, and manufacturer's recommendations for Consultant review a minimum of two weeks prior to placement or use of products.

.2 Submit details of proposed methods of concrete curing and provisions for weather protection for Consultant review a minimum of two weeks prior to placement.

.3 Submit manufacturer's product data sheets for proposed curing compounds, admixtures, and corrosion inhibitors.

.4 Do not commence placement of concrete until review is complete and proposed products and procedures are accepted by Consultant.

1.5 Qualifications

.1 Use only qualified concrete placers and finishers, with a minimum of two years' experience in similar work.

2.0 PRODUCTS

2.1 Materials

.1 Portland Cement: Type GU to CSA A3000.

.2 Aggregate: Natural stone to CSA A23.1.

.3 Water: Potable and to CSA A23.1.

.4 Air Entraining Agents: To ASTM C260/C260M.

.5 Chemicals Admixtures: To CSA A3000. Calcium chloride is not permitted.

.6 Pozzolanic Mineral Admixtures: To CSA A3000.

.7 Curing Materials: To CSA A23.1.

.8 Blended Hydraulic Cementing Material: Type 10SF to CSA A3000.

.9 Supplementary Cementing Material: To CSA A3000.

.10 Superplasticizing Admixture: To CSA A3000.

2.2 Mix Design Requirements – Concrete Slab-on-Grade

.1 Normal weight "ready mixed" Portland cement concrete mixed in accordance with Section 4, Durability Requirements, Class of Exposure C-2 of CSA A23.1, with the following requirements:

	Description	Requirements
.1	Compressive Strength (28 days)	32 MPa minimum
.2	Air Content	5.0% to 8.0%

	Description	Requirements
.3	Aggregate Size	20 mm
.4	Slump	
	- Prior to Superplasticizer	50 mm maximum ± 20 mm
	- After Superplasticizer	125 mm maximum ± 25 mm
.5	Water/Cementing Materials Ratio	0.45 maximum
.6	Cement Content	335 kg/m^3 minimum
.7	Cement – Type GU	Normal Portland Cement
.8	Concrete Density	Normal weight (2,360 kg/m^3)

.2 Should the Contractor wish to employ superplasticizers to facilitate concrete placement, the Contractor must demonstrate to the satisfaction of the Consultant that such admixtures are non-chloride based and will have no deleterious effect on the durability or strength of the proposed concrete mix (i.e. freeze-thaw durability).

2.3 Air Entrainment

.1 Air entraining chemical admixtures shall be according to ASTM C260. Ensure chemical admixtures are compatible with each other and that they will not negatively impact performance of the concrete.

.2 The total fresh air content of air entrained concrete will be tested via the pressure method with an air meter prior to the placement of concrete in accordance with CSA A23.2.

.3 Air content in hardened concrete shall meet the requirements of CSA A23.1 and this specification and, if directed by the Consultant, will be tested and determined in accordance with ASTM C457 as outlined in CSA A23.1.

2.4 Cement Slurry Bonding Agent

.1 Cement slurry grout consisting of a mixture of one part cement to one part fine aggregate and enough water to make a “heavy cream” consistency. Aggregate to conform to CSA A23.1 Clause 4.2.3.

3.0 EXECUTION

3.1 Concrete Surface Preparation

.1 Clean all existing concrete surfaces to receive new concrete of foreign material, dust, debris, grease, and oil as directed by Consultant. Emulsifiers shall be required for surfaces containing grease or oil.

.2 Notify Consultant to review surfaces prior to concrete placement.

3.2 Concrete Placement - Ready-Mixed Concrete

.1 The patch area shall be thoroughly wetted for a minimum of three hours, and longer where required to achieve a saturated surface dry (SSD) state, prior to placing of concrete.

.2 Puddles or free water shall be blown from the patch area and the surface permitted to dry to a saturated surface dry (SSD) state prior to application of cement slurry.

.3 Apply a cement slurry bonding agent to the surface of the concrete just prior to placing new concrete.

.4 The cement slurry bonding agent shall be broomed or scrubbed into the deck to fully saturate the surface but not to be allowed to puddle.

.5 Pre-wet fabric, burlap, cotton mats, or pre-approved alternative shall be available on site prior to placement of concrete to allow for immediate placement overtop of new concrete patches after their initial set.

.6 Addition of water shall conform to CSA A23.1. Do not add water after the initial introduction of mixing water at the plant unless the measured slump tested at the onset of discharge is less than specified requirements and less than 60 minutes have elapsed from the time of batching. Water may only be added in this circumstance under the on-site direction of the producer’s Quality Control Inspector. In no instance shall more than 16 L of water be added per cubic metre of concrete. The resulting concrete must satisfy specified requirements. The responsibility for the product will remain with the Contractor.

.7 On slab top surfaces, place new dense concrete thoroughly compacted and vibrated into place to ensure good bond.

.1 Ensure reinforcing steel is secured in place and is not disturbed during placement.

.2 Vibrators are to be used for consolidation purposes only and are not to be used to an extent that causes segregation of the concrete.

.3 Internal vibrators shall conform to CSA A23.1 Clause 7.2.5.2 and Table 19: Internal Vibrators for Various Applications.

.4 Vibrators shall be inserted into concrete perpendicular to concrete surface.

.5 Vibrators shall be inserted such that zones of consolidation always overlap.

.8 Concrete surfaces to be flush with existing surfaces, free of voids and cracks, and have a uniform surface and transition to the existing surface.

.9 Finish concrete in accordance with CSA A23.1/A23.2. Initial finish shall be completed before any bleeding or free water is present on the surface of the concrete. Final finishing shall commence after the bleed water has disappeared and when the concrete has stiffened sufficiently to prevent the working of excess mortar to the surface. Do not add water to finish.

.10 Do not overwork concrete surface. Wood float finish is acceptable.

.11 Do not use steel trowels with air-entrained concrete. For air-entrained concrete, the surface can be further leveled and consolidated with a magnesium bull float for larger repairs or a magnesium trowel for smaller repairs. One or more passes shall be made at suitable time intervals to obtain a level finish free of float marks. Do not work bleed water on the concrete surface into the concrete during finishing.

.12 If mechanical floats are to be used for final finishing of larger air entrained concrete surfaces, the mechanical floating of the concrete surface shall commence as soon as the concrete surface has reached initial set and will support the weight of a power float machine equipped with magnesium float blades and the operator.

.13

.14 Cure concrete as outlined in this section.

.15 Do not allow traffic on newly placed repair patches until 75% of the specified 28-day strength has been reached.

3.3 Concrete Mixing and Placing

.1 Concrete shall be machine mixed. Mixing and placing shall be in accordance with CSA A23.1.

.2 Concrete shall be conveyed from the mixer to the place of deposit by methods that will ensure the required quality of concrete. Equipment for conveying the concrete shall be of such size and design as shall ensure a practically continuous flow of concrete at the delivery end without separation of materials.

.3 Concrete shall be deposited into patch repairs as near as practicable to its final position to avoid re-handling.

.4 Depositing shall be continuous throughout each division and the concrete shall be placed and worked so that a uniform texture will be produced.

.5 No concrete shall be placed later than one half hour after leaving the mixer. No re-tempered concrete shall be placed.

3.4 Compaction and Vibration

.1 Concrete shall be consolidated by means of sufficient vibrators of adequate size operated by competent workers.

.2 The use of vibrators to transport concrete shall not be allowed.

.3 Concrete shall be thoroughly worked around reinforcement, around embedded items, and into corners.

.4 Compaction and vibration is to eliminate all air and stone pockets that may cause honeycombing, pitting, or planes of weakness.

3.5 Concrete Curing

.1 Initiate surface concrete repair wet curing as soon as possible after the concrete has sufficiently set, and no later than 30 minutes after finishing.

.1 Minimum acceptable wet curing method on slab surfaces is installation of pre-saturated filter fabric, burlap, or cotton mats that are covered with soaker hoses and plastic sheeting. Overlap wet-curing mats 150 mm and ballast in place without marring the concrete surface.

.2 Wet curing procedures are to keep the concrete surfaces continuously wet for a period of at least 10 consecutive days at a minimum temperature of 10°C. Do not permit water to evaporate completely from the concrete surfaces at any time within the wet cure period.

.3 Prevent airflow in the space between the wet-curing mats and the plastic sheeting.

.2 Provide the Consultant with proposed wet-curing procedures at least 2 weeks prior to concrete placement. Any revisions to the proposed procedures must be submitted to the Consultant for review a minimum of one week prior to concrete placement.

.3 The use of chemical curing compounds is not permitted.

.4 Protect concrete from the harmful effects of heat, cold, running or surface water, and mechanical shock.

.5 Do not place concrete when air temperature is below 10°C, or without implementing provisions to ensure proper curing of concrete when -- in the opinion of the Consultant -- there is a possibility of air temperature falling below 10°C. These provisions shall be reviewed by the Consultant and conform to the requirements of CSA A23.1.

.6 Maintain concrete material and forms between 15°C and 32°C until concrete placement whenever the surrounding air is below 5°C. No frozen material or material containing ice shall be used. All existing concrete, reinforcement, forms, and ground that the concrete will contact is to be free from frost.

.7 Maintain a curing temperature above 10°C for 10 days or longer to ensure proper concrete curing. Under no circumstances may dry heat be used. Provide means to humidify the air within the heated enclosure and ensure that moisture requirements for curing are maintained.

.8 Do not allow traffic onto patch until material has adequately cured to 75% of its specified 28-day compressive strength.

.9 The Consultant will have cause to not certify payment for repairs undertaken without adequate wet-curing procedures or that become surface dry during the specified curing period.

3.6 Inspection and Testing

.1 To conform to CSA A23.2.

.2 Inspection and testing to be conducted by a testing agency designated by the Owner. The Owner will pay costs of inspection and testing described in this section.

.3 Contractor to inform testing agency 24 hours in advance of concrete placement.

.4 Testing shall include:

.1 Preparation and testing of concrete cylinders for compressive strength.

.2 Establishment of slump and the percentage of entrained air for each concrete truck, unless otherwise directed by Consultant.

.3 Review of concrete mix designs submitted by the Contractor.

.4 Submission of test results to the Owner, Consultant, and Contractor.

.5 A minimum of one set (4 cylinders) of concrete cylinders shall be taken for compressive strength testing of concrete patch material used each day unless otherwise directed by Consultant. Concrete cylinders are to be placed in an area with similar curing conditions to that of the cast concrete.

.5 Testing procedures for concrete shall conform to the following requirements:

.1 Compression tests on concrete shall be carried out in accordance with CSA A23.2 and A23.1 except that a Strength Test shall consist of four test cylinders and one cylinder shall be tested at the age of 3 days, the second cylinder shall be tested at the age of 7 days, and the remaining two at an age of 28 days.

.2 Slump and air entrainment test shall be conducted at the time of sampling concrete for compressive tests and shall be conducted in conformity with CSA A23.2. Slump and air entrainment tests shall be performed on all loads used each day.

.6 The Contractor shall provide at no additional costs to the Owner:

.1 Samples of all material required for testing.

.2 Cooperation with the execution of concrete testing, which shall include protection against injury or loss of cylinders.

.3 Access for the testing agency to test and/ or inspect materials.

.4 Site storage facilities meeting requirements of CSA A23.2 for concrete test specimens prior to removal to laboratory.

.7 Contractor shall pay for costs of additional testing as follows:

.1 Additional standby time required due to late delivery by concrete supplier.

.2 Additional slump and/or air tests if first tests indicate that concrete properties are outside of specified requirements and the Contractor wishes to modify the mix and retest. All modifications are to be approved by the Consultant.

.3 If the Contractor fails to notify the testing agency of pour cancellation.

3.7 Field Quality Control

.1 The Consultant shall evaluate bonding of fresh patch material to existing concrete after the fresh patch material has cured sufficiently.

.2 The evaluation shall be performed by acoustical sounding, using a "chain-drag" or other techniques.

.3 Hollow sounds detected in repair area provide reason to suspect inadequate bonding. Contractor to core these areas to determine bonding adequacy where requested by the Consultant.

.4 Coring shall be through the new concrete and into the existing concrete. Core diameter shall be 75 mm, or as required by the Consultant. Length of cores shall be twice the core diameter or twice the thickness of new concrete, unless otherwise requested by the Consultant.

.5 Scanning is to be completed prior to coring to avoid coring through embedded reinforcing, conduit, or other embedded items.

.6 Cores will be visually inspected after removal and any further testing that is required will be determined by the Consultant.

.7 Contractor to patch core holes.

3.8 Rejection of Defective Work

.1 The Consultant shall have the right to order additional concrete testing of any portion of repairs in accordance with CSA A23.1 if previous testing demonstrates non-conformance with specified requirements. The testing company shall be selected by the Consultant and shall deal directly with the Consultant. Payment for costs associated with the additional concrete testing will be at the Contractor's expense.

.2 Where it is the Consultant's opinion that material or workmanship fails to meet the specified requirements, the work shall be replaced or repaired to the approval of the Consultant at no additional cost to the Owner.

.3 Bond failure between repair material and the existing concrete, or failure to meet compressive strength requirements based on compression testing of concrete cylinders, will result in drilling of additional core samples at the Contractor's expense. Failure of these additional samples will require the work to be replaced or repaired to the approval of the Consultant at no additional cost to the Owner.

3.9 Record Drawings

.1 Maintain accurate records of the location, size, and concrete placement date for each repair area.

.2 Records are to be kept up-to-date and made available to the Consultant for review throughout the duration of the Work.

.3 Prior to Substantial Performance of the Work, provide a plan showing location, size, and date of concrete repairs.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Polished concrete finish system (CON-1):

.1 Surface preparation and grinding.

.2 Apply hardener and polish concrete to specified finish.

.3 Edge and corner grinding/polishing with hand tools for polished concrete finish at perimeter of structural elements and at concrete curbs.

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20 and in accordance with Concrete Floor Contractors Association Technical Bulletin entitled “Pre-Construction Meetings”.

.1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer’s *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Submit plan indicating polished concrete surface locations, including locations of joints.

.4 Samples:

.1 Submit 300 x 300 mm (12” x 12”) samples of each specified material and finish, in each specified colour to show successive applications of each coat.

.5 Test reports:

.1 Submit abrasion resistance test results.

.2 Submit slip resistance test results for hardened concrete.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer’s maintenance instructions for incorporation into the operation and maintenance manuals.

1.5 Quality Assurance

.1 Qualifications:

.1 *Subcontractor*: Shall be a member in good standing of the Concrete Floor Contractors Association.

.2 Installers:

.1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

.2 Has successfully completed installations similar to the proposed installation, including scale and complexity, within the past 5 years.

.3 Submit applicator's certification showing applicator's good standing with *Product* manufacturer.

.2 Mock-ups:

.1 *Provide* mock-up at the *Place of the Work* as part of final installation for approval, location and size as indicated and confirmed by *Consultant*.

.2 Mock-up shall include edge and corner polished concrete finish at perimeter of structural elements and at concrete curbs and joint filler.

1.6 Field Conditions

.1 Comply with polished concrete manufacturer's written requirements for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting work of this section.

.2 Concrete floor must be level surface to minimum tolerances as follows in accordance with CAN/CSA A23.1/A23.2-14 with no defects, shall comply with value specified in Section 03 35 03.

.3 Substrate shall be steel trowelled (3 pass), cured for a minimum of 28 days, damp cured a minimum of 7 days following concrete placement, sound, dry, free of dust, dirt, paint, grease, oil or other foreign substances.

.4 Provide adequate ventilation during installation.

.5 Advise other trades of fixtures and fittings not to be installed until floor finish materials are cured.

.6 Protect adjacent surfaces from damage resulting from work of this section. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, and the like, by suitable means.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Performance criteria; hardener treated polished 24 MPa concrete:

.1 Abrasion resistance: in accordance with ASTM C779/C779M-19, Procedure A, 30 minutes: 0.2 mm (0.008").

.2 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) to match existing polished concrete flooring.

2.2 Polished Concrete

.1 Source quality control:

.1 Source concrete finishing components and materials from single manufacturer.

.2 Provide polished concrete system as specified herein and conforming to the following requirements:

.1 Aggregate exposure; depth of grind: to match existing polished concrete flooring.

.2 Finish: Natural finish.

.3 Polish level: Level 2; semi-gloss finish.

2.3 Polished Concrete Systems

.1 Acceptable *Products*:

.1 Euclid Canada 'Double Diamond Concrete Polishing'.

.2 Retroplate Canada (Ashford Formula) 'Retroplate'.

.3 W.R. Meadows 'Induroshine'.

.4 Substitutions: in accordance with Section 01 25 00.

2.4 Polished Concrete Floor Finish Products

.1 Concrete hardener:

.1 Acceptable *Products*:

.1 Euclid Canada 'Euco Diamond Hard'.

.2 Retroplate Canada (Ashford Formula) 'RetroPlate 99'.

.3 W.R. Meadows 'Liqui-hard'.

.4 Substitutions: in accordance with Section 01 25 00.

.2 Concrete finish enhancer:

.1 Acceptable concrete enhancer *Products*:

.1 Euclid Canada 'UltraGuard'.

.2 Retroplate Canada (Ashford Formula) 'RetroGuard'.

.3 W.R. Meadows 'Bellatrix'.

.4 Substitutions: in accordance with Section 01 25 00.

.3 Stain guard sealer: Ready to use, is a low odour, VOC compliant, topical sealer consisting of low molecular emulsified cross-linking, coupling polymers that effectively protect concrete and other natural stone floor surfaces from the damaging effects of staining, defacing and deterioration due to contaminant penetration.

.1 Acceptable *Products*:

.1 Euclid Canada 'UltraGuard'.

.2 Substitutions: in accordance with Section 01 25 00.

.4 Cleaning solution: Proprietary, mild, highly concentrated liquid concrete cleaner and conditioner containing wetting and emulsifying agents; biodegradable, environmentally safe and certified High Traction by National Floor Safety Institute (NFSI), as approved by polished concrete system manufacturer.

.5 Water: Clean, free oil, soluble salts or other deleterious substances.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that specified environmental conditions are ensured before commencing the work of this section.

.2 Examine surfaces to receive finish system. Concrete surfaces shall be smooth, sound, dry, and free from conditions that will adversely affect execution, permanence, or quality of the work of this section. Test surfaces for moisture content using manufacturer's recommended test procedure to ensure that they are suitable for application, and fully cured.

.3 Verify that surfaces have been *Provided* as specified in the work of other sections, that they will not adversely affect execution, permanence, or quality of the work of this section, and that they can be put into acceptable condition by means of preparation specified in this section.

.4 Concrete slabs shall have sound surface free of dust, chemicals, grease, oil, laitance and curing agents, and cured to requirements of manufacturer of hardening agent.

.5 Commencement of work shall imply acceptance of surfaces and conditions. Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

.6 If any substrate deficiency is apparent, notify *Contractor* in writing prior to commencing work.

.7 Site verification of conditions:

.1 Verify that concrete substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's requirements prior to installation of concrete finishing materials.

.8 Concrete slab performance requirements:

.1 Cure concrete in accordance with manufacturer's written requirements.

.2 Concrete surfaces shall receive a hard steel-trowel finish (3 passes) during placement.

.1 Machine-trowel surfaces as close as possible to walls and columns and minimize use of hand tools.

.3 Overall floor flatness shall comply with value specified in Section 03 35 03.

.9 Surfaces after trowelling shall not show trowel or burn marks, and mottling.

3.2 Preparation

.1 After acceptance of surfaces, prepare surfaces as required by the polished concrete manufacturer.

.2 Cover or mask surfaces adjacent to those receiving finish system to protect work of others and property from damage and soil.

.3 Grinding and hardening at vertical barriers, perimeter of structural elements and at concrete curbs in accordance with approved mock-up.

3.3 Installation

.1 Apply polished concrete finish system in accordance with polished concrete manufacturer's written requirements.

.2 Grind, polish and harden concrete surfaces to match accepted samples and mock-ups. Match approved samples in sheen, colour and texture.

.3 Hardening and polishing of concrete surfaces:

.1 Application shall not take place until after at least 30 days of placement of concrete.

.2 Application is to take place at least 10 days prior to installation of equipment or furnishings, thus providing a complete, uninhibited concrete slab for application

.3 Applicable procedures must be followed as recommended by the *Product* manufacturer and as required to match approved test sample.

.4 Achieve increased impermeability, hardening, dust-proofing, and abrasion resistance of the surface while imparting a sheen.

.5 Apply special concrete hardener finish in accordance with manufacturer's requirements.

.4 Finish enhancer application:

.1 Apply number of coats of concrete finish enhancer in accordance with manufacturer’s written requirements. After application of concrete finish enhancer, burnish within 2 hours after the *Product* application.

.5 Erect barriers to prevent the entry and presence of personnel not performing work of this section during application of hardener/sealer, and for 12 hours following completion of application.

3.4 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Inspection and testing:

.1 Independent inspection and testing company shall verify slip resistance of polished concrete flooring in-situ on mock-up sample.

.2 Manufacturer shall provide field review in accordance with Section 01 45 00.

3.5 Adjusting and Cleaning

.1 Touch up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

.2 Wash polished concrete surfaces with a neutral cleaner, rinse with clean water and allow to dry.

.3 Protect polished concrete from staining and damage.

END OF SECTION

PART 1 – GENERAL

1.1 Summary

.1 Section includes:

.1 Cementitious underlayment in locations as indicated, to achieve flush and level floor finishes as specified in Division 09.

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.2 Submit for approval a list of the system materials intended for use in the *Work* for each condition before installation commences.

.3 Certificates:

.1 Manufacturer's certification that the *Product* is Portland cement-based having an inorganic binder content which is a minimum 80% Portland cement when tested per ASTM C150/C150M-16e1 - Standard Specification for Portland Cement.

.2 Manufacturer's certification that *Product* specified is suitable for intended use when installed in accordance with manufacturer's written installation requirements.

1.4 Quality Assurance

.1 Qualifications:

.1 Applicators:

.1 Shall have 5 years' experience, minimum, in application of *Products* specified and with approval and training of *Product* manufacturer.

.2 Mock-ups:

.1 Provide 1830 mm x 2440 mm (6'-0" x 8'-0") area in location as selected by *Consultant*.

PART 2 - PRODUCTS

2.1 Materials

.1 Self-levelling cementitious underlayment system:

.1 Description: Primer and mix of special cements and binders which, when mixed with water, become highly liquid cement compound that seeks its own level and produces flat, smooth surfaces.

.2 Compressive strength: 5000 psi, minimum, at 28 days, to ASTM C109/C109M-16a (air cure only).

.3 Aggregate: well graded, washed gravel 3 mm to 6 mm (1/8" to 1/4") or larger for use when underlayment is installed over 38 mm (1-1/2") thickness.

.4 Each material used in the application of self-levelling cementitious underlayment shall be as approved or manufactured by *Supplier* of cementitious underlayment.

.5 Colour: Natural cement grey.

.1 Thickness: as required to meet the specified tolerances.

.2 Acceptable *Products*:

.1 Ardex Engineered Cements ‘ARDEX K-15 Self-Levelling Underlayment Concrete’.

.1 Primer: ‘ARDEX P-51’ for standard absorbent concrete, and as recommended by cementitious underlayment manufacturer for other concrete porosities.

.2 Custom Building Products 'CustomTech TechLevel XP1 Self Leveling Underlayment’.

.1 Primer: Type as recommended by cementitious underlayment manufacturer for other concrete.

.3 Mapei ‘Ultraplan 1 Plus’.

.1 Primer: Type as recommended by cementitious underlayment manufacturer for other concrete.

.4 Substitutions: in accordance with Section 01 25 00.

.2 Water: Clean, potable, and sufficiently cool and not warmer than 21°C (70°F).

.3 Gypsum underlayment *Products* will not be accepted.

2.2 Mixing

.1 Mix in accordance with manufacturer's written requirements.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that specified field conditions are achieved before commencing work of this section.

.2 Surfaces to receive cementitious underlayment shall be smooth, sound, dry, and free from conditions that will adversely affect execution, permanence, or quality of the work of this section and in accordance with manufacturer's written requirements.

.3 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

.1 Substrate shall be sound, dry, and free of dust, dirt, paint, grease, oil or other foreign substances.

.2 Fill voids that allow the mix to run through the substrate.

.3 Keep other *Subcontractors* from area to be poured during day of pour. Keep heavy work off of cementitious underlayment for at least 2 to 4 hours following pour, in accordance with cementitious underlayment manufacturer's written requirements.

.4 Protect adjacent surfaces from damage resulting from work of this section. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, and the like by suitable means.

.5 Erect barriers to prevent entry and presence of personnel not performing work of this section during application of cementitious underlayment.

.6 Mechanically roughen and clean substrate, by shot blasting in accordance with cementitious underlayment manufacturer's written requirements.

3.3 Applications

.1 Verify that cementitious underlayment manufacturer's required conditions have been met at the *Place of the Work* prior to commencing application.

.2 Prime prepared substrate and apply cementitious underlayment in accordance with manufacturer's written requirements.

.3 Finished surface shall be true to plane within ±3 mm (1/8”) in a 3m (10’-0”) as described in ACI 117-10, straightedge in accordance with CAN/CSA A23.1/A23.2-14.

.4 Apply cementitious underlayment such that no laps, voids, or other marks or irregularities are visible and may telegraph through to finished flooring installed under Division 09.

.5 Do not cover or bridge expansion joints or control joints. *Provide* 3 mm (1/8") wide sawcut joints over concrete slab control joints.

.6 Feather cementitious underlayment to level with adjacent finished floor heights to within 3 mm (1/8”).

3.4 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 Test for moisture vapour transmission in accordance with ASTM F1869-16a. Concrete floors shall be dry, and exhibit negative alkalinity, carbonization, or dusting. Maximum percentage of moisture acceptable is 1.4 kg/93 m^2 (3 lb/1000 ft^2) in a 24 hour period, unless otherwise specified by manufacturer’s printed literature.

.2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-17.

.3 For each test type: Perform 3 tests for flooring applications less than 2000 ft^2 in area, and 1 test per additional 186 m^2 (1000 ft^2).

3.5 Adjusting and Cleaning

.1 Remove promptly as work progresses spilled or spattered cementitious underlayment materials from surfaces. Clean floors upon completion of the work of this section.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Work of this section includes metal fabrications identified on the drawings.

1.1 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Submit list of fabrications to be *Provided* as part of the work of this section.

.3 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.4 Shop drawings:

.1 Include plans, sections and large scale details, and indicate components and methods of assembly, materials and their characteristics, fastenings, metal finishes, welds, and their structural characteristics relative to their purpose, and other fabrication information required.

.2 Indicate proposed *Place of the Work* connections and methods.

.3 Submit coordination drawings indicating locations of concealed grounds, cutouts, plates, and other required fabrications.

.4 Show relation to adjoining construction, details of outside and inside corners and door openings.

1.3 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit operation and maintenance data for incorporation into maintenance manual specified in Section 01 78 00.

1.4 Quality Assurance

.1 Qualifications:

.1 *Subcontractor*:

.1 Has adequate plant, equipment, and skilled tradespersons to perform work expeditiously.

.2 Has successfully completed installations similar to that required in the *Work* during a period of at least the immediate past 5 years.

.2 Requirements of regulatory agencies: the work of this section that functions to resist forces imposed by dead and live loads shall conform to requirements of jurisdictional authorities.

.3 Mock-ups:

.1 Supply and install finished mock-ups, as indicated or scheduled, for review and acceptance by *Consultant*:

.1 - MET-1 countertop complete with front edge and backsplash.

.2 - MET-1 divider in Exam Rooms.

.3 - MET-1 corner guard.

1.5 Delivery, Storage, and Handling

.1 For aluminum fabrications comply with AAMA CW-10-15 – Care and Handling of Architectural Aluminum from Shop to Site.

.2 Label, tag or otherwise mark metal fabrications supplied for installation by other sections to indicate its function, location in building and shop drawing designation.

.3 Protect work from damage during delivery, storage and handling.

.4 Deliver work to location at the *Place of the Work* designated by *Contractor* and to meet requirements of construction schedule.

.5 For metalwork items which are susceptible to damage from construction activities provide strippable temporary protective film on factory finished or prefinished surfaces before shipping.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Design, fabricate, and install work of this section in accordance with the building code and requirements of authorities having jurisdiction.

.2 Welding:

.1 Steel: Weld components to conform to requirements of CSA W59-18, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-19 and CSA W55.3-08 (R2018) as applicable.

.2 Stainless steel: Weld components to conform to requirements of CSA W59-18 and ANSI/AWS D1.6/D1.6M-2017 as applicable, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-19.

.3 Aluminum: Weld components to conform to requirements of CSA W59.2-18, and by a fabricator certified by the Canadian Welding Bureau to conditions of CSA W47.2-11(R2020).

.3 Design assemblies and connections to withstand own dead load, live loads, super-imposed dead loads, and fabrication forces, without permanent distortions or deformation, to maximum allowable deflection of L/360, within the following construction tolerances:

.1 Edges and surfaces shall be uniform for like metalwork.

.2 Limit inconsistencies in edge and surfaces to those which can be identified when viewed from distance of not greater than 300 mm (12").

.3 Maximum variation from plumb in vertical lines: 3.2 mm (1/8") in 3 m (10'-0").

.4 Maximum variation from level: 3.2 mm (1/8") in 9 m (30'-0").

.5 Maximum variation from straight: 3.2 mm (1/8") in 3 m (10'-0") under a 3 m (10'-0") straight edge.

.6 Maximum variation from angle indicated: 10 seconds.

.7 Tolerances shall be non-cumulative.

2.2 Materials

.1 General:

.1 Unless detailed or specified otherwise, standard *Products* will be acceptable if construction details and installation meet requirements of the *Contract Documents*.

.2 Include materials, *Products*, accessories, and supplementary parts necessary to complete assembly and installation of work of Section 05 50 00.

.3 Incorporate only metals that are free from defects that are visible, or that impair strength or durability. Install only new metals that are of best quality, free from rust or waves and buckles, clean, straight, with sharply defined profiles.

.2 Steel:

.1 Structural shapes, plate, bars: hot-rolled, in accordance with CSA G40.21-13, Grade 300W.

.2 Hollow structural sections: hot-formed, seamless, in accordance with CSA G40.21-13, Grade 350W, Class H.

.3 Mild sheet and strip: hot rolled, in accordance with ASTM A1011/A1011M-14.

.4 Cold rolled sheet: stretcher levelled, fully pickled, in accordance with ASTM A1008/A1008M-13, Grade CS Type A exposed, matte finish, dry, unless otherwise indicated.

.5 Steel pipe: in accordance with ASTM A53/A53M-12, Type E or S, Grade A or B, standard weight, Schedule 40 seamless black or AISI MT 1010/1015.

.3 Stainless steel:

.1 Type 304 unless otherwise indicated.

.2 Stainless steel tubing: in accordance with ASTM A269/A269M-15a, Commercial Grade, seamless welded.

.3 Stainless steel sheet and plate: in accordance with ASTM A167-99(2009).

.4 Stainless steel bar and angle: in accordance with ASTM A276/A276M-17.

.5 Stainless steel seamless pipe: in accordance with ASTM A312/A312M-17.

.4 Aluminum:

.1 Aluminum extrusions: Alloy 6063-T5 or T6 to ANSI H35.1/H35.1M-2017.

.2 Aluminum sheet: aluminum alloy 5005H14 to ANSI H35.1/H35.1M-2017. Exposed sheet shall be machine flattened free of distortions, resquared sawcut edges.

2.3 Accessories

.1 Fasteners:

.1 Exposed fasteners to match the material surface on which they occur.

.2 For fastening steel: Zinc plated screws and bolts, and in accordance with ASTM A307-21, Type 304 stainless steel where exposed to exterior.

.3 For fastening stainless steel: Stainless steel 300 Series or stainless steel 400 Series.

.4 For fastening aluminum: Stainless steel 300 Series, stainless steel 400 Series, cadmium plated or aluminum.

.5 High strength bolts: in accordance with ASTM A325-14.

.6 Concrete anchors; exterior exposed to weather: embedded epoxy set anchors, unless otherwise indicated.

.1 Size: in accordance with manufacturer's written requirements and reviewed shop drawings. Embedment depth shall not be greater than 80% of concrete thickness.

.7 Other types of fasteners as appropriate to meet design requirements.

.8 Fasteners shall be tamperproof where exposed.

.2 Welding materials:

.1 Steel: in accordance with CSA W59-18.

.2 Aluminum: in accordance with CSA W59.2-18.

.3 Stainless steel: in accordance with ANSI/AWS D1.6/D1.6M-2017.

.3 Grout:

.1 Epoxy grout; non-shrink, non-expanding.

.1 Acceptable *Products*:

.1 Hilti 'HY-200'.

.2 Sika 'Sika AnchorFix 3001'.

.3 W.R. Meadows 'REZI-WELD 3/2 EPOXY GROUT/PATCH'.

.4 Substitutions: in accordance with Section 01 25 00.

.2 Cementitious grout: non-shrink, non-expanding in accordance with ASTM C1107/C1107M-20:

.1 Acceptable *Products*:

.1 Sika 'Sika Grout 212' or 'Sika M-Bed Standard'.

.2 W.R. Meadows 'Sealtight CG-86 Construction Grout'.

.3 Substitutions: in accordance with Section 01 25 00.

.4 Dielectric separator: Best grade, quick drying non-staining alkali resistant bituminous paint in accordance with CAN/CGSB 1.108-M89, or membrane type to acceptance of *Consultant*.

.5 Adhesive; metal base: one component polyurethane based, moisture-curing adhesive, waterproof, and paintable.

.1 Acceptable *Products*:

.1 LePage 'PL Premium Polyurethane Construction Adhesive'.

.2 Substitutions: in accordance with Section 01 25 00.

2.4 Finishes

.1 Shop primer; premium quality:

.1 Acceptable *Product*:

.1 Sherwin-Williams 'Pro Industrial Pro-Cryl Universal Primer', 0.0076 mm (3 mils) DFT.

.2 Zinc rich paint; steel: Two-component zinc-rich coating, zinc powder in accordance with ASTM D520-00(2019) Type III ,SSPC-Paint 20, Type 1 Inorganic or single-component zinc-rich coating to SSPC-Paint, Type 2 Organic, CAN/CGSB 1.181-M99, VOC content <100 g/l to ASTM D1475-13(2020).

.1 Acceptable Products:

.1 Aervoe Industries, Inc. 'Low VOC Cold Galvanize Coating 93% Zinc'.

.2 ZRC Worldwide 'ZRC Zero-VOC Galvanizing Compound'.

.3 Substitutions: in accordance with Section 01 25 00.

.3 Hot dip galvanizing: in accordance with ASTM A123/A123M-13, minimum zinc coating of 600 g/m². Use air cooling method (no water or chromate dipping treatment permitted).

.4 Stainless steel: in accordance with AISI No. 4 brushed finish.

.5 Aluminum: Clear anodized in accordance with AAMA 611-20, designation AA-M10C22A31.

2.5 Fabrication

.1 General:

.1 Fabricate metal fabrications with machinery and tools specifically designed for the intended manufacturing processes and by skilled tradesmen.

.2 Fit and assemble metal fabrications in shop. When this is not possible, make a trial shop assembly.

.3 Incorporate means for fastenings of other work secured to work of this section.

.2 Construction:

.1 Fabricate with materials, component sizes, metal gauges, reinforcing, anchors, and fasteners of adequate strength to withstand intended use, and within allowable design factors imposed by jurisdictional authorities. Fabricate items from steel unless otherwise noted.

.2 Metal fabrications shall remain free of warping, buckling, opening of joints and seams, distortion, and permanent deformation.

.3 Assembly:

.1 Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.

.2 Provide smooth welds with splatter removed where exposed to view.

.1 Finish welds shall comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #4 - Good quality, uniform undressed weld with minimal splatter as shown in NAAMM-AMP 521-01(R2012).

.3 Allow for differential movements within assemblies and at junctions of assemblies with surrounding *Work*.

.4 Field welding of hot dipped galvanized members permitted only when other fastening methods are not possible. Locations of field welds to be clearly identified on reviewed shop drawings.

.5 Incorporate holes and connections for work installed under other sections.

.6 Cleanly and smoothly finish exposed edges of materials including holes.

.7 Cap open ends of sections exposed to view, such as pipes, channels, angles, and other similar work.

.4 Shop prime painting; premium quality:

.1 Clean loose mill scale, rust, dirt, weld flux and spatter from work after fabrication.

.2 Clean and prepare surfaces to meet specified requirements of SSPC SP-6 and paint manufacturer’s installation requirements.

.3 Apply primer in accordance with paint manufacturer’s installation requirements.

.5 Galvanizing:

.1 Galvanize metal fabrications following fabrication.

.2 Paint damage galvanized surfaces with zinc rich paint, immediately following damage to galvanized protection. Prepare substrate to remove oil and grease to SSPC-SP1-16, rust scale to SSPC-SP3-18, mill scale to SSPC-SP6/NACE No. 3-07.

.3 At interior locations, fill vent and drain holes exposed in the finished *Work* by plugging with zinc solder and filing off smooth.

.6 Fabrications exposed to view:

.1 Fabrications exposed to view shall be of the highest architectural quality, free of scratches, pitting, roughness, marring, discolouration, seams, staining and other imperfections with the quality of workmanship conforming to the workmanship classifications of Class 1 as defined in NAAMM AMP 555, paragraph 8.3 of Section 8, Quality Control or Assurance and as follows:

.1 Exposed surfaces are finished smooth with pits, mill marks, nicks and scratches filled or ground off. Defects shall not show when painted or polished. Remove sharp corners and edges.

.2 Conceal welds where possible. Where exposed, grind welds to small radius with uniform sized cove. Welds shall appear continuous in appearance. When painted or polished welds shall be undetectable.

.3 Use only flat head countersunk bolts in exposed locations unless indicated otherwise.

.4 Distortions shall not be visible to the eye.

.5 Exposed joints shall be fitted to hairline finish.

.2 Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

.3 Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

.4 Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the work.

.5 Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

.6 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm (0.040") unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

.7 Mill joints to a tight, hairline fit. Cope or mitre corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

.8 Surface preparation; non-ferrous metals: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.

PART 3 - EXECUTION

3.1 Examination

.1 Take measurements at the *Place of the Work* to verify that metal fabrications fit surrounding construction, around obstructions and projections in place, or as indicated, and to suit service locations.

3.2 Installation

.1 Install metal fabrications plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding work.

.2 Include in work of this section anchor bolts, high tensile bolts, washers and nuts, expansion bolts, toggles, straps, sleeves, brackets, clips, and other items necessary for secure installation as required by loading and jurisdictional authorities.

.3 Countersink holes at wood screw locations where wood is attached to work of this section.

.4 Attach metal fabrications to interior concrete and masonry with corrosion resistant expansion bolts to support load with a safety factor of 3.

.5 Insulate between dissimilar metals or between metal, and masonry or concrete with bituminous paint to prevent electrolytic action.

.6 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

3.3 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Inspection and testing:

.1 Test stainless steel for free iron in accordance with ASTM A380/A380M-17. If test results or inspections show stainless steel work to be contaminated with free iron or other impurity which can lead to discolouration of stainless steel work when exposed to moisture, remove and replace or repair the stainless steel work in accordance with recommendation of Nickel Development Institute and as required to provide stainless steel which meets the requirements of this section.

3.4 Adjusting and Cleaning

.1 After erection, touch up primed surfaces that are burned, scratched or otherwise damaged with prime paint to match shop paint.

.2 Clean and repair areas of bare metal and welds on galvanized surfaces with zinc rich paint. Mask welded areas of members to minimize overpainting of adjacent undamaged surfaces. Prepare substrate to remove oil and grease in accordance with SSPC-SP1-16, rust scale in accordance with SSPC-SP3-18, mill scale in accordance with SSPC-SP6/NACE No. 3-07.

.3 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.

3.5 Metal Fabrications Schedule

.1 Refer to metal fabrications identified on the drawings.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 The work of this section includes, but is not necessarily limited to, the following:

.1 Plywood backing panels.

.2 Wood grounds, nailers, blocking and sleepers.

.3 Wood base.

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Shop drawings:

.1 Clearly indicate details of construction, profiles, jointing, fastening and other related details.

1.3 Delivery, Storage, and Handling

.1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

PART 2 - PRODUCTS

2.1 Wood Materials

.1 General requirements:

.1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content not greater than 19% at time of installation, in accordance with following standards:

.1 CSA O141-05.

.2 NLGA-2014 Standard Grading Rules for Canadian Lumber.

.2 Furring, blocking, nailing strips, grounds, base:

.1 Use S2S material.

.2 Dimension lumber sizes: in compliance with Section 12 of the NLGA-2014.

.3 Dimension lumber species and grades:

.1 Spruce-Pine-Fir.

.2 Wood base at columns:

.1 Poplar.

.3 Light framing in accordance with NLGA-2014 Construction grade, S-Dry.

.4 Planks in accordance with NLGA-2014 No. 2 grade, S-Dry.

.5 Boards in accordance with NLGA-2014 No. 4 Common grade, S-Dry.

.3 Curbs, nailers, plywood for roofing: Spruce species, NLGA construction grade, sound and free of imperfections or deficiencies making unsuitable for use. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.2 Panel Materials

.1 Softwood plywood (CSP): in accordance with CSA O151-09.

.2 Douglas Fir plywood (DFP): in accordance with CSA O121-08.

2.3 Fastenings and Hardware

.1 General:

.1 *Provide* fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 38 mm (1-1/2") into wood substrate.

.2 Anchors to concrete and unit masonry: Capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M-22, conducted by a qualified independent inspection and testing company.

.3 Use surface fastenings of following types, except where specific type is indicated.

.1 To hollow masonry, plaster and panel surfaces use 9 mm (11/32") expansion bolts or other acceptable anchor.

.2 To solid masonry and concrete use expansion bolts.

.3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws, or welded stud-bolts.

.4 Fastener materials:

.1 Hot-dip galvanized fasteners: in accordance with ASTM A153/A153M-09 Class A or B1 G185 and connectors meeting ASTM A653/A653M-13 Class G-185 sheet or better.

.5 Hardware materials:

.1 Hot-dipped galvanized in accordance with ASTM A153/A153M-09, Class A or B1, and connectors in accordance with ASTM A653/A653M-13, Class G185.

2.4 Source Quality Control

.1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

PART 3 - EXECUTION

3.1 General

.1 Layout work to accommodate work of others. Cut and fit accurately. Erect in position indicated. Align, level, square, plumb, and secure work permanently in place.

.2 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolt head and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of work.

.3 Include in work of this section rough hardware such as nails, bolts, nuts, washers, screws, clips, and connectors required for complete and proper installations; and operating hardware required on work of this section for temporary use.

.4 Do not attach work by wood plugs or blocking in concrete or masonry.

.5 Do not regard nailers, blocking, and such other fastening provision indicated as exact or complete. Install required provisions for fastening, located and secured to suit *Place of the Work* conditions, and adequate for intended support.

.6 Verify that grounds required for fastening of components and equipment are located correctly, and sized for adequate support.

3.2 Equipment Backboard

.1 *Provide* backboards for mounting equipment as required. Use 19 mm (3/4") Softwood Plywood.

.2 Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28 for requirements for electrical backboards.

3.3 Miscellaneous Plywood Blocking

.1 *Provide* minimum 19 mm (3/4") softwood plywood blocking for attachment of miscellaneous fitments as indicated.

.2 Wood blocking within gypsum board metal stud assemblies under work of Section 09 22 00.

3.4 Grounds, Blocking, Strapping, Furring, Sleepers and Nailers

.1 Refer to Sections 09 22 00 and 09 29 00, for the installation of wood blocking and/or sheet metal backup for fastening of wall mounted accessories and casework/millwork.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Work of this section includes architectural woodwork including, but not limited to, the following:

.1 Cabinetry and hardware.

.2 Plastic laminate fabrications and countertops (PLAM-1, PLAM-4, and PLAM-5).

.3 Engineered stone countertops (SSM-1).

.4 Factory finishing of architectural woodwork.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate with other work for satisfactory and expeditious completion of the work of this section. Coordinate with partition accessories, electrical, communications, and finish components to ensure that proper provisions are made for the installation of the work of this section and for work by others.

.2 Where woodwork is to be fitted to other construction, check actual dimension of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delays in the *Work*.

.3 *Provide* forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the work of this section and set in place. Instruct applicable *Subcontractors* as to their locations.

.4 *Provide* cut-outs for raceways, sleeves, grommets and other manufactured accessories which are required for the work of this section and for work by others.

.2 Conduct a pre-fabrication meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data for each type of *Product* and process proposed for use in the work of this section and incorporated into items of architectural woodwork.

.3 Shop drawings:

.1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.

.2 Submit engineered shop drawings, including seismic design, connections and restraint.

.3 Indicate quality standards and grades.

.4 Include full scale drawings of all exposed-to-view edge conditions.

.5 Include plans, sections and large scale details, and indicate components and methods of assembly, fastenings, and other fabrication information required for the work of this section. Indicate assembly joint lines.

.6 Include materials and their characteristics and finishes as applicable including the following:

.1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.

.2 Adhesive types to be used and locations.

.3 Finishing requirements including North American Architectural Woodwork Standards 4.0 finish system number, sheen, and required application steps.

.7 Submit coordination drawings indicating locations of concealed grounds, cut-outs, plates, and other required fabrications.

.8 Show relation to adjoining construction, details of outside and inside corners and door openings.

.9 Provide flame spread ratings of walls and ceiling finishes to meet building code requirements, tested and listed by accredited listing agency.

.4 Selection samples:

.1 Casework hardware, one unit of each type and finish.

.5 Verification samples:

.1 Submit samples for purpose of verification of compliance with specified requirements.

.2 Submit 3 sets of 200 mm x 200 mm (8” x 8”) samples, or 200 mm (8”) long as applicable, of each specified *Product*, material and finish, including but not limited to the following:

.1 Shop finished materials, showing each type of finish and colour.

.2 Samples of each specified *Product*, in each specified colour and finish.

.3 Engineered stone in each specified colour and finish.

.4 Plastic laminates, in each specified colour and finish.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.

.3 Maintenance materials:

.1 Deliver extra sets of hardware items for maintenance as follows:

.1 2 % of each type actually installed, but not less than 2 sets.

1.5 Quality Assurance

.1 Qualifications:

.1 Manufacturers:

.1 Architectural woodwork shall be manufactured by a firm having a minimum of 5 years experience on work of similar size and quality.

.2 Shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.

.3 Fabricator solid surfacing: Fabrication to be performed by a solid surface manufacturer's certified fabricator. Submit certification letter prepared by the solid surfacing manufacturer.

.2 Installers / applicators / erectors: engage an installer who has successfully completed 2 architectural woodwork projects similar in scope, materials and design to this *Project* within the last 5 years.

.2 Quality standard:

.1 Work shall be in accordance with the North American Architectural Woodwork Standards 4.0, Premium Grade, or the highest grade available for performance and appearance characteristics of materials in Sections 3 – 5 used that apply to *Product* fabrication and installation requirements governed by Sections 6 – 12.

.3 Requirements of regulatory agencies: the work of this section that functions to resist forces imposed by dead and live loads shall conform to requirements of jurisdictional authorities.

.4 Mock-ups: Provide complete mock-ups of woodwork fabrications for the following:

.1 Solid surface (SSM-1) countertop complete with front edge and 100mm radius on vertical corner.

.2 PLAM-1 upper cabinet.

.3 PLAM-1 drawer.

1.6 Delivery, Storage, and Handling

.1 Protect architectural woodwork during transit, delivery, storage and handling to prevent damage, spoilage, and deterioration.

.2 Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate architectural woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified under paragraph 1.7 Field Conditions.

.3 The architectural woodwork manufacturer and the *Contractor* shall be jointly responsible to make certain that architectural woodwork is not delivered until the building and storage areas are sufficiently dry so that the architectural woodwork will not be damaged by excessive changes in moisture content.

1.7 Field Conditions

.1 Environmental conditions:

.1 During storage and installation: Obtain and comply with North American Architectural Woodwork Standards 4.0 for optimum temperature and relative humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained. Woodwork shall be acclimatized for a minimum of 72 hours prior to commencing woodwork installation.

.2 During finishing: Comply with Architectural Woodwork Standard's temperature and humidity requirements before, during, and after application of finishes.

.3 During service life of woodwork: Obtain and comply with woodwork manufacturer's advice for optimum temperature and humidity conditions.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Casework integrity shall meet the minimum acceptance levels in accordance with SEFA 8-1999 as outlined in the North American Architectural Woodwork Standards 4.0 and additional or greater loading capacities as specified throughout the North American Architectural Woodwork Standards 4.0.

.2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the North American Architectural Woodwork Standards 4.0 based on shelf thickness indicated or scheduled.

2.2 Wood Materials

.1 Lumber:

.1 Hardwood for concealed blocking and framing: Custom grade, any species that, when painted, will not show any defects.

.2 Hardwood for exposed blocking: species and grade to match panel veneer.

.3 Moisture content: *Provide* kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.

2.3 Panel Materials

.1 Panel material schedule; except where indicated otherwise:

.1 Thickness: as indicated on drawings.

.2 Core panels:

.1 At plastic laminate and melamine work: Particle board and MDF, as indicated.

.2 Plywood backing; countertops, backsplashes, and where indicated: Exterior grade plywood with no added urea-formaldehyde used in composition.

.3 Maximum moisture content at time of installation: 10% to 12%.

.2 Plywood:

.1 Veneer core plywood non telegraphing grain: Sanded good one side or good two sides (when both sides exposed or to receive applied finish materials) plywood:

.1 Hardwood plywood: to ANSI/HPVA HP-1-2009.

.2 Softwood plywood: to US Plywood Standard APA PS-1-09 Structural Plywood (with Typical APA Trademarks).

.3 Medium density fibreboard (MDF):

.1 To ANSI A208.2-2016, 720 kg/m^3 (45 lbs/ft^3) minimum density and as follows:

.1 Grade:

.1 Grade 130.

.2 Formaldehyde emission: No added urea-formaldehyde used in composition.

.4 Particleboard:

.1 To ANSI A208.1-2009, and as follows:

.1 Industrial grade:

.1 M-3i Medium density; between 640 - 800 kg/m^3 (40 - 50 lb/ft^3).

.2 Formaldehyde emission: No added urea-formaldehyde used in composition.

2.4 Plastic and Composite Materials

.1 Low pressure decorative laminate; melamine particleboard panels:

.1 Particleboard conforming to ANSI A208.1-2009, grade M3i, board consisting of 100% pre-consumer wood fibre containing no added urea-formaldehyde resins, with thermally fused melamine resin impregnated decorative paper facing to ANSI/NEMA LD 3-2005, complete with matching non-yellowing edge trim, unless otherwise noted.

.2 Colours: as indicated on Material Legend.

.2 High pressure decorative laminate; typical (PLAM-1, PLAM-4, and PLAM-5):

.1 General purpose grade: ANSI/NEMA LD 3-2005, Horizontal General Purpose Grade (HGS).

.2 Post forming grade: ANSI/NEMA LD 3-2005, Horizontal Performable Grade (HGP).

.3 Colours, finishes, and patterns: as indicated on Material Legend.

.3 Engineered stone; quartz-based fabricated stone surfacing (SSM-1):

.1 Composition: 93% crushed quartz aggregate combined with resins and pigments and fabricated into slabs using a vacuum vibro-compaction process, and as follows:

.1 Thickness: as indicated.

.2 Acceptable *Product*, colour, finish: Refer to Material Legend.

.2 Accessories:

.1 Joint adhesive: Manufacturer's standard adhesive to create inconspicuous, nonporous joints, with a chemical bond.

.2 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

.3 Sink/bowl mounting hardware: Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of undermount sinks/bowls.

2.5 Fasteners and Adhesives

.1 Fasteners shall comply with North American Architectural Woodwork Standards 4.0

.2 Adhesives: Shall be used for intended purpose and manufacturer materials applications and installation, applied in accordance with manufacturer's written requirements and shall comply with the "adhesive usage guidelines" recommendations of North American Architectural Woodwork Standards 4.0

2.6 Hardware

.1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.

.1 Where casework hardware is not specified or indicated on drawings or scheduled, casework hardware shall comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the North American Architectural Woodwork Standards 4.0.

.2 Pulls: Aluminum edge pull; Product #BP9898 by Richelieu or approved equivalent.

.1 Sizes:

.1 Lower Cabinets and Drawers: 192 mm.

.2 Vertical Pull: 416 mm.

.3 Upper Cabinets: 128 mm.

.3 Concealed Hinges:

.1 Soft-close European Hinge: Nickel plated, with 110° pivot point; CLIP-top Series #973A by Blum or approved equivalent.

.2 Piano Hinge: Continuous, chrome or nickel plated steel piano hinge; minimum 0.75 mm thick; width as required to support panel weight.

.3 Push-open Hinge: Nickel plated; TIP-ON by Blum or approved equivalent.

.4 Shelf Supports: Nickel plated steel, for 5 mm drill holes, 80 kg load bearing capacity; Item #282.04.711 by Hafele America Co., or approved equivalent.

.5 Drawer Slides: Electro-plated zinc screw mounted, heavy duty, full extension type with captive profile to eliminate side movement, soft close, positive in and out stops and, load capacity to suit drawer size with minimum static load rating of 27 kg for drawers 150 mm and less, and 40 kg for drawers over 150 mm in depth, lengths to suit application, side-mounted type.

.1 Product: Metabox 320 Series by Blum or approved equivalent.

.6 Silencer: Round vinyl, self-adhered, provide 2 per door.

.7 Magnetic Catch: Cast aluminum; 918 by Knape & Vogt or approved equivalent.

.8 Push Latch: Heavy duty magnetic; maximum 10 lbs opening force; Category #245.75.330 by Hafale America Co. or approved equivalent.

2.7 Finishes - Interior Architectural Woodwork

.1 General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.

.2 Preparations for finishing:

.1 Prior to finishing, exposed portions of woodwork shall have handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish. Sanding shall be completed just prior to stain or finishing application.

.2 Concealed surfaces of woodwork that might be exposed to moisture, such as those adjacent to exterior concrete or masonry walls, shall be back-primed.

.3 Comply with referenced quality standard in Part 1 for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

2.8 Fabrication

.1 Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises pre-cut, where possible, to receive hardware and other items of work.

.2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, provide ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.

.3 *Provide* woodwork, solid tops and other indicated materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and *Provide* proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.

.4 *Provide* framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.

.5 Reinforcing shown is minimum. *Provide* additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.

.6 *Provide* balancing sheets as required, and specified, complying with the North American Architectural Woodwork Standards 4.0.

.7 *Provide* surface mount blocking & strapping necessary to support the work of this section. Such blocking shall not be exposed upon completion of work.

.8 Prefinish work at the factory, except where specified or indicated otherwise.

2.9 Fabrication - Engineered Stone

.1 Fabricate components in shop to greatest extent practical to size and shape indicated, in accordance with reviewed shop drawings and manufacturer's written requirements.

.2 Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 100 mm (4") wide solid surfacing material reinforcing strip under joints.

.3 *Provide* holes and cut-outs as indicated or as required.

.4 Rout and finish component edges to a smooth, uniform finish. Rout cut-outs then sand edges smooth. Repair or reject defective or inaccurate work.

.5 Surfaces shall have a uniform finish.

PART 3 - EXECUTION

3.1 Preparation

.1 Condition woodwork to field conditions in installation areas before installing. Ensure that field conditions have been provided as requested and specified.

.2 Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

.3 *Provide* all grounds, nailers and other required fabrications which are to be built into other work when required.

.4 Ensure that wall and ceiling variations are not in excess of 6.4 mm (1/4") in 3658 mm (144") and that floors are not in excess of 12.7 mm (1/2") in 3658 mm (144") of being plumb, level, flat, straight, square, of the correct size. Variations shall be corrected prior to installation of work of this section.

.5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 Installation

.1 Install woodwork to comply with North American Architectural Woodwork Standards 4.0 for same grade specified in Part 1 of this section for type of woodwork involved.

.2 Install woodwork plumb, level, true, and straight with no distortions.

.3 Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

.4 Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

.5 Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

3.3 Installation - Tolerances

.1 Install to a tolerance of 3 mm in 2400 mm (1/8" in 8’-0”) for plumb and level (including tops) and with no variations in flushness of adjoining surfaces unless otherwise acceptable in accordance with the North American Architectural Woodwork Standards 4.0.

3.4 Adjusting and Cleaning

.1 Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork.

.2 Clean, lubricate, and adjust hardware.

.3 Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 Protection

.1 Protect architectural woodwork during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.

.2 *Provide* final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that woodwork is without damage or deterioration at time of *Substantial Performance of the Work*.

END OF SECTION

1.0 GENERAL

1.1 Reference Standards

.1 All referenced Standards are latest editions referenced by the Building Code in the Place of the Work, or latest editions if not referenced by Code.

.2 Ontario Building Code

.3 CAN/CGSB-51.34 Vapor Barrier, Polyethylene Sheet for Use in Building Construction (Withdrawn)

.4 CAN/CGSB-19.21 Sealing and Bedding Compound, Acoustical (Withdrawn)

1.2 Waste Management and Disposal

.1 Collect, package, and store polyethylene cut offs and waste material for recycling.

2.0 PRODUCTS

2.1 Polyethylene Sheet Vapour Retarder

.1 To CAN/CGSB-51.34, 0.15 mm thick, polyethylene film.

2.2 Accessories

.1 Joint Sealing Tape: Air resistant pressure-sensitive adhesive tape, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.1 205-02 Tuck Contractor’s Sheathing Tape by Cantech

.2 Moulded Vapour Retarder Boxes: Factory-moulded polyethylene shells for use with recessed electric switch and outlet device boxes.

3.0 EXECUTION

3.1 Installation

.1 Ensure services are installed and reviewed prior to installation of vapour retarder.

.2 Use sheets of largest practical size to minimize joints. Arrange all joints to occur on solid bearing.

.3 Inspect sheets for continuity. Repair punctures and tears with sealing tape before installations are concealed.

.4 Cut and tailor sheet vapour retarder to form openings and ensure material is lapped and sealed to frames.

.5 Seal lap joints of sheet vapour retarder as follows:

.1 Attach first sheet to substrate.

.2 Apply continuous bead of sealant over solid backing at joint.

.3 Lap adjoining sheet minimum 150 mm and press into sealant bead.

.4 Install staples through lapped sheets at sealant bead into substrate.

.5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

.6 Seal electrical switch and outlet device boxes that penetrate sheet vapour retarder as follows:

.1 Install moulded vapour retarder boxes.

.2 Apply sealant to flange of moulded vapour retarder box.

.3 Lap sheet onto flange, pressing sheet into sealant.

.4 Seal wiring penetrations through box back and sides.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Materials installed in joints to restrict the spread of fire and smoke.

.1 Joints in or between fire-resistance-rated constructions.

.2 Section excludes:

.1 Firestopping and smoke seals, for mechanical, electrical and communications penetrations of fire resistant assemblies, and firestopping and smoke seals within their respective assemblies. Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate joint firestopping and smoke seal work with Section 01 33 01.

.2 Coordinate with other sections to assure that pipes, conduit, cable, and other items that penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.

.3 Schedule the *Work* to assure that penetrations and other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.

.2 Conduct a pre-installation meeting in accordance with Section 01 31 20.

.1 Representatives for mechanical and electrical work and independent inspection and testing company shall attend pre-installation meeting.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Product data sheets: Submit data and installation instructions for *Products* providing descriptions sufficient for identification at the *Place of the Work*.

.1 Materials list of *Products* proposed for use in the work of this section; complying with listed systems designs.

.2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.

.3 Certificates:

.1 Submit the following certification documents with closeout submittals:

.1 Manufacturer’s certification: Submit manufacturer's certification that installed firestopping and smoke seal *Products* are suitable for the use indicated and comply with specified requirements.

.2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.

.4 Submit fire resistance rating test listings for firestopping and smoke seal systems.

.3 Shop drawings:

.1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.

.2 Designate on shop drawings static and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.

.3 Engineered shop drawings; for engineering judgements:

.1 Where *Project* conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each Project location and condition.

.2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both *Project* name, *Project* location, and *Subcontractor*'s name who will install firestop system as described in engineering judgement shop drawings.

.3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.

.4 For perimeter fire barrier systems:

.1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.

.4 Manufacturers' instructions:

.1 Manufacturer of *Products* proposed for use in work of this section shall prepare firestopping manual scheduling products to be used for each assembly and installation required in the *Work*.

.1 Coordinate with project firestopping manual specified under Section 01 33 00.

.2 Manual shall include manufacturer's *Product* data sheets as specified under paragraph 1.3.2.

.3 Firestopping manual shall be submitted within 4 weeks of *Contract* award.

1.4 Quality Assurance

.1 Qualifications:

.1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval, training and certification of *Product* manufacturers.

.1 Submit proof of manufacturer's installer certification for each installer of firestopping and smoke sealant systems.

.1 Manufacturer's willingness to sell its firestopping *Products* to the *Contractor* or to an installer engaged by the *Contractor* does not in itself confer qualification on the buyer.

.2 Applicator shall designate a single individual as *Project* foreperson who shall be present at the *Place of the Work* at all times throughout the work of this section when the work of this section is being performed.

1.5 Delivery Storage, and Handling

.1 Deliver materials to *Place of the Work* in manufacturer's unopened containers, containing classification label, with labels intact and legible at time of use.

.2 Store materials in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

.3 Do not use damaged or adulterated materials and materials exceeding their expiry date.

1.6 Field Conditions

.1 Comply with manufacturer's requirements relative to temperature and humidity conditions, before, during and after installation.

PART 2 - PRODUCTS

2.1 Manufacturers

.1 General: Manufacturers of firestopping and smoke seal system *Products* and installation specialists for the work of this section are limited to applicable assemblies as required for the *Work* and having listing mark on packaging.

.2 Subject to compliance with requirements, provide products by one of the following:

.1 3M Canada Inc.

.2 Hilti Canada Corp.

.3 NUCO Inc.

.4 STI Firestop.

.5 Tremco Commercial Sealants & Waterproofing.

2.2 Performance/Design Requirements

.1 Firestop and smoke sealant systems shall consist of material, or combination of materials installed to retain integrity of fire-rated construction by effectively impeding spread of flame, smoke, and/or hot gasses through perimeter joint or gaps, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.

.2 Smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material shall form air tight barriers to prevent passage of gas and smoke.

.3 Fire-resistance rating of firestopping system shall be equivalent to rating of adjacent floor, wall or other fire separation assembly.

.4 Firestopping system at fire rated assemblies with assembly STC rating requirements shall provide STC rating equal to STC rating of fire rated assembly.

.5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with *Consultant* prior to application.

.6 *Provide* movement capability at movement joints in accordance with design requirements for movement joint.

.7 Head-of-wall joints; with dynamic designation:

.1 Joint assemblies shall permit vertical movement allowing wall to move independent of structure due to forces including, but not limited to, live loads, dead loads, thermal expansion/contraction, and wind sway. Such movement shall not damage the wall assembly or its fire protection components.

.1 Provide head-of-wall joints with dynamic designation.

.8 Regulatory requirements:

.1 Joint firestop systems shall be listed in accordance with CAN/ULC-S115-11 and shall achieve required fire resistance rating in accordance with building code.

.2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.

2.3 Materials

.1 Single source responsibility for firestopping and smoke seal materials:

.1 Obtain firestopping and smoke seal materials from single manufacturer for each different *Product* required.

.2 Manufacturer shall instruct applicator in procedures for each material.

.2 Firestopping and smoke seal systems shall conform to the following:

.1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN/ULC-S115-11 and not to exceed opening sizes for which they are intended.

.2 *Provide* firestopping materials and systems with fire-resistance rating not less than the fire-resistance rating of applicable adjacent assembly.

.3 Listed in accordance with CAN/ULC-S115-11.

.4 Use only joint firestop systems that have been tested by an accredited third party testing agency for specific fire-rated construction conditions conforming to construction assembly type, joint type and fire-rating requirements for each separate instance.

.1 Where there is no specific third party tested and classified firestop system for a particular firestop configuration, submit engineered shop drawings.

.5 For joints in fire-separations, provide listed systems designs for the joint firestop and smoke seal systems as required by building code to maintain the integrity of the fire separations.

.6 *Products* shall be compatible with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with requirements of *Contract Documents* and manufacturer of selected materials being installed.

.3 Smoke sealants for overhead and vertical joints shall be non-sagging; sealants for floors shall be self-levelling.

.4 Smoke seal sealant colour at exposed locations: Grey. (Red will not be accepted).

PART 3 - EXECUTION

3.1 Preparation

.1 Examine sizes, anticipated movement and conditions to establish correct thickness and installation of back-up materials.

.2 Prepare surfaces in accordance with manufacturer's written specifications and to requirements of listed system designs.

3.2 Installation

.1 Install joint firestopping and smoke seal systems in accordance with manufacturer’s written requirements and in compliance with listed system designs. Products and installation requirements must comply with listed system designs.

.2 For materials that will remain exposed after completing the *Work*, finish to achieve smooth, uniform surfaces. Tool or trowel exposed surfaces.

.3 Notify *Consultant* when random completed installations are ready for review, as directed by *Consultant*, prior to concealing or enclosing firestopping and as applicable, smoke seals.

.4 Protect materials from damage on surfaces subjected to traffic.

3.3 Identification and Documentation

.1 Provide documentation for each joint firestop system application addressed. This documentation is to identify each joint location on the entire Project.

.2 Documentation for installed joint firestop systems is to include:

.1 Sequential location number.

.2 Project name.

.3 Date of installation.

.4 Detailed description of joint firestop system location.

.5 Listed firestop system design number or engineered judgment number.

.6 Type of joint.

.7 Width of joint.

.8 Overall length of joint.

.9 Number of sides addressed.

.10 Hourly rating of firestop joint system to be achieved.

.11 Installers name.

3.4 Field Quality Control

.1 Conduct quality control to be in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 Examine completed firestop joint installations to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspections are completed.

.2 Inspection consultant to review installation of the work of this section and to perform random tests to verify its completion in accordance with the requirements of the *Contract Documents*.

.3 Give at least 48 hours notice before operations commence, and arrange for a pre-job conference with *Contractor*, installer, independent inspection and testing company, manufacturer, and *Consultant* present.

.4 Independent inspection and testing company shall examine installed firestopping in accordance with ASTM E2393-20a. Independent inspection and testing company shall examine firestopping and shall determine, in general, that firestopping has been installed in accordance with requirements of the *Contract Documents* and in compliance with each listed firestop system design.

.5 Representatives of the manufacturer(s) shall have access to the *Work*. *Contractor* shall provide assistance and facilities for such access in order that the manufacturer(s) representative(s) may properly perform its function.

.2 Manufacturer’s field review to be in accordance with Section 01 45 00.

END OF SECTION

PART 1- GENERAL

1.1 Summary

.1 Section includes:

.1 Joint sealants – interior locations.

.2 Section excludes:

.1 Glazing system assembly sealants.

.2 Fluid-applied flooring sealants.

.3 Mechanical and electrical sealants.

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

.1 The following items shall be addressed at the pre-installation meeting:

.1 Analysis of the work.

.2 Shape factor of the joint.

.3 Recommendations for priming joints.

.4 Inspection of surfaces and joints.

.5 Compatibility of materials.

.6 Backing materials.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer’s *Product* data sheets for *Products* proposed for use in the work of this section.

.2 Submit manufacturer's and *Product* name for each sealant which will be used in the *Work* prior to commencing the *Work*.

.3 Samples:

.1 Submit "wet sample" sealant colour samples for each sealant *Product* and colour.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.1 Include manufacturer’s warranties.

.2 Maintenance instructions:

.1 Submit maintenance instructions for all items for incorporation into the operation and maintenance manuals.

1.5 Quality Assurance

.1 Qualifications:

.1 *Subcontractor*:

.1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified.

.2 Installer to comply with quality assurance articles referenced in ASTM C1193-16 for installation of joint sealants.

1.6 Field Conditions

.1 Conform to sealant manufacturer's specifications and recommendations.

.2 Do not proceed with installation of joint sealants under the following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or are below 5° C (40° F).

.2 When joint substrates are wet.

.3 Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Interior sealants shall have a VOC limit of 50 g/L maximum, unless otherwise specified, and comply with South Coast Air Quality Management District (SCAQMD) Rule 1168, Adhesive and Sealant Applications.

.2 Joint sealants:

.1 Shall perform as air tight and water-tight joints.

.2 Defects shall include, but are not limited to:

.1 Staining from abutting materials or filler.

.2 Migrating, bleeding into, or staining abutting materials.

.3 Unsightly surface deformation.

.4 Excessive colour change, chalking, or dust pick-up.

.5 Failing adhesively or cohesively where maximum elongation is less than 25% of designed width of exposed joints.

.6 Hardening to more than 25% over specified hardness.

2.2 Sealants

.1 General:

.1 Single source responsibility: Obtain joint sealant from a single manufacturer for each joint sealant type.

.2 Colours: Sealant colours shall match colours of adjacent materials, as selected and approved by *Consultant*.

.1 Colours: shall be selected from manufacturer's full range of colours.

.3 In accordance with ASTM C920-14 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920-14 classifications for type, grade, class, and uses.

.4 For sealants to be applied to porous substrates:

.1 Provide products that have undergone testing in accordance with ASTM C1248-22 and have not stained porous joint substrates indicated for *Work*.

.5 Sealant supplied shall not exude any material(s) which travel into adjacent materials, or travel onto surfaces of adjacent materials; causing damage, or attracting soiling, which becomes apparent during the service life of the building.

.2 Interior general sealants:

.1 VOC limit: Maximum 50 g/L, unless otherwise indicated.

.2 Interior sealant; at joints with painted gypsum board: one-component paintable acrylic or polyurethane sealant, in accordance with ASTM C834-10; Type OP, Grade -18° C, zero VOC.

.3 Interior sealant; gap filler: at movement paintable joints in vertical surfaces: One-component polyurethane sealant in accordance with the following: ASTM C920-14, Type M or S, Grade NS, Class 25.

.1 Acceptable *Products*:

.1 Master Builders Solutions Canada 'MasterSeal NP100'.

.2 Sika 'Sikaflex 15LM'.

.3 Substitutions: in accordance with Section 01 25 00.

.4 Interior sealant, mildew resistant one part silicone sealant in accordance with the following: ASTM C920-14, Type S, Grade NS, Class 25.

.1 Acceptable *Products*:

.1 DOWSIL '786'.

.2 Momentive 'Sanitary SCS1700 Sealant'.

.3 Sika 'Sikasil GP'.

.4 Tremco, Inc. 'Tremsil 200'.

2.3 Accessories

.1 General: *Provide* joint sealants, primers, backings, and fillers that are compatible with one another and with joint substrates and other sealants or joint fillers specified and approved for applications indicated under joint sealant scheduled and under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience. When incompatible, inform *Consultant* and change to compatible type acceptable to *Consultant*.

.2 Cylindrical sealant backings: *Provide* joint backings that meet ASTM C1330-02, Type O (open-cell polyurethane), or Type B (non-absorbent bi-cellular backing materials with surface skin), sized 25 percent or greater than joint opening with proper density to control sealant depth and profile. Follow joint sealant manufacturer's recommendations with backing selections for optimum joint sealant performance, in accordance with the following schedule:

.1 Use open cell foam with non-absorbing closed cell skin (Sof-Rod) for vertical joints; round shape for open joints and triangular shape for angular joints.

.2 Use closed cell foam for horizontal joints.

.3 Bond-breaker tape: Polyethylene tape or other approved plastic tape as recommended by joint sealant manufacturer to prevent 3-sided joint adhesion to rigid, inflexible joint fillers or joint surfaces at back of joint where such adhesion would restrict proper sealant movement or result in sealant failure.

.4 Masking tape: Non-staining, non-absorbent and compatible with joint sealants and adjacent surfaces.

.5 Sealant primers: Use primers only as recommended by sealant manufacturer where required to enhance adhesion of sealant to specific joint substrates indicated and as determined for use from pre-construction mock-up testing. Select primers in consultation with sealant manufacturer and manufacturer of substrate material which do not have a detrimental effect on sealant adhesion or in-service performance.

.6 Cleaners for nonporous surfaces:

.1 *Provide* non-staining, chemical cleaners of type which are acceptable to manufacturer of sealant and sealant backing material, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

.2 *Provide* cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.

PART 3 - EXECUTION

3.1 Manufacturer's Recommendations

.1 Unless specified otherwise herein, comply with the recommendations and directions of the manufacturer whose materials are being used in the work of this section.

3.2 Preparation

.1 Protect adjacent work areas and finished surfaces from damage during joint sealant installation.

.2 Clean and prepare joint surfaces and substrates of substance that could impair the bond of joint sealants immediately before installing joint sealants.

.3 Provide a dry, dust-free and cleaned substrate for optimum results.

.4 Clean porous joint surfaces by using heavy-duty brushing, light abrasive, mechanical abrading or combination of these methods to produce a clean, sound surface for optimum bond with joint sealants per manufacturer's recommendations.

.5 Clean non-porous surfaces using the two-cloth wipe method as referenced in ASTM C1193-16 and outlined by joint sealant manufacturer's written requirements.

.6 Prepare rusting or scaling surfaces using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Remove and neutralize efflorescence, mould, mildew and algae prior to joint sealant installation.

.7 Prepare finish-coated surfaces per joint sealant manufacturer's specific recommendations.

.8 Test materials for indications of staining or poor adhesion before any sealing is commenced. Submit reports in writing to *Consultant* of results.

3.3 Masking

.1 Where necessary to prevent contamination or marring surfaces of adjacent materials, mask areas adjacent to joints with masking tape prior to priming or sealing application. Remove tape immediately after joint has been completed and an initial set achieved.

3.4 Installation

.1 Install in accordance with joint sealant manufacturer's installation written requirements for products, primers and applications indicated unless more stringent project-specific instructions or requirements apply.

.2 Apply joint sealants for continuous waterproof sealant joint protection. Lap vertical joints over horizontal joints as recommended by sealant manufacturer. Comply with installation recommendations in ASTM C1193-16 for use of joint sealants as applicable to each specific sealant installation.

.3 Install sealant primers only when recommended by sealant manufacturer and demonstrated at pre-construction tests after joint surface preparation has been completed and when surfaces are verified as clean and dry. Allow any primer installation to completely dry or cure prior to installation of backing or joint sealants. Primer is mandatory for gun applied sealants.

.4 Install joint sealants using proven techniques that comply with the following and in proper sequence with installation of primers and backings.

.1 Using proper joint sealant dispensing equipment, place sealants by pushing sealant beads into opening to fully wet-out joint sealant substrates. Fill sealant joint opening to full and proper configuration.

.2 *Provide* uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's written requirements.

.5 Joint sealant tooling is required for non-sag joint sealant installations. Immediately after placing fresh sealants and before skinning or curing begins, tool sealants using metal spatulas designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth, uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.

.1 Provide concave joint configuration as indicated per figure 5-A in ASTM C1193-16 unless otherwise indicated.

.2 Use tooling agents that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.

.3 Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.

.6 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer.

.7 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the *Contract Documents*.

.8 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.

.9 Check form release agent used on concrete for compatibility with primer and sealant. If they are incompatible inform *Consultant* and change primer and sealant to compatible type, or clean concrete to sealant manufacturer's acceptance.

.10 Install joint backing material, filler strips, gaskets, bond breakers and similar type material of comparable performance characteristics. Install bond breaker tape or packing over asphalt impregnated fibre board as recommended by sealant manufacturer.

.11 Where joints are 12.7 mm (1/2") or deeper, insert backing material in continuous uniform compression with setback from finished face of adjoining materials equal to required depth of sealant (width/depth ratio) as specified herein.

.12 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.

.13 Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.

.14 Maintain correct sealant depth. Sealant depth shall be 1/2 the width of the joint, maximum depth shall be 12.7 mm (1/2"), minimum depth shall be 6 mm (1/4"). Comply with manufacturer's written recommendations.

.15 Fillet bead sealant joints to be sized to provide proper contact area with substrates, in accordance with manufacturer's written recommendations.

.16 Apply sealants using pressure-operated guns fitted with suitable nozzles in accordance with manufacturer's directions. Apply sealants in such manner as to ensure good adhesion to sides of joints and to completely fill voids in joints.

.17 Apply sealants so that surfaces of joints are smooth, full bead, free from ridges, wrinkles, sags, air pockets and embedded impurities. Tool sealant surfaces to produce a smooth surface.

.18 Install sealant with exterior face of sealant set back 10 mm (3/8") from face of adjacent materials at building movement joints, unless otherwise indicated.

.19 Do not apply sealants to areas where installation of paints, coatings or flooring is in progress. Apply sealants after such work is complete and fully cured.

3.5 Interior Sealant Schedule

.1 Include in work of this section sealants to seal open joints in surfaces exposed to view, and to make building weather-tight and air-tight, as applicable, as indicated, and as otherwise specified, except where specified under the work of other sections.

.2 Install sealant to:

- .1 Movement and control joints on exposed insitu concrete walls.
- .2 Interior control and expansion joints in floor and wall surfaces.
- .3 Raked out joints at junctions of masonry with concrete walls and columns, and at intersection of masonry walls and partitions where joint reinforcement is installed.
- .4 Perimeters of exterior and interior door and window frames.
- .5 Joints at tops of non-load bearing masonry walls at the underside of insitu concrete.
- .6 Exposed interior control joints in gypsum board.
- .7 Millwork junctions with walls.
- .8 Laboratory casework and floor finishes.

.3 Mildew resistant sealant at wet areas:

- .1 Perimeter joints of wet fixtures such as:
  - .1 Water closets.
  - .2 Sinks.
- .2 Counter/wall junctions at countertops.

3.6 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

- .1 Inspection and testing:
  - .1 Record field adhesion testing on digital video camera and submit to *Consultant*.
  - .2 Document and perform field adhesion testing in accordance with manufacturer’s recommended field-adhesion requirements and submit written reports co-signed by sealant manufacturer’s representative.

.3 Perform 5 field adhesion tests for the first 300 m (1000 lineal feet) and one test in each 300 m (1000 lineal feet) of sealant joint length thereafter. One (1) test per floor height and per elevation is also recommended. When the sealant is used to weatherseal between 2 dissimilar substrates, the sealant adhesion to each side of the joint should be individually tested.

.4 Field test joint sealants in accordance with Method A, Field-Applied Sealant Joint Hand-Pull Tab, in Appendix X-1 in ASTM C1193-16 and in compliance with manufacturer's specific recommendations.

.5 Evaluation: In compliance with joint sealant manufacturer, joint sealants tested and not indicating adhesive failure within the substrates are considered satisfactory results. For joint sealants that fail to adhere to the substrate, clean, re-install and then re-test until satisfactory results are obtained.

3.7 Adjusting and Cleaning

.1 Remove droppings and clean off excess sealant or sealant residue adjacent to sealant joint installations as the work progresses by methods approved by joint sealant manufacturer before material achieves initial set.

.2 Do not damage adjacent surfaces with harmful removal techniques and protect finished surfaces beyond those that have been masked.

.3 Remove and replace damaged joint sealants.

.4 Remove temporary coverings and masking protection from adjacent work areas upon completion.

3.8 Protection

.1 Protect installed sealants during and after final curing from damage resulting during construction.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Hollow metal doors and panels (steel doors).

.2 Metal frames (steel frames, transom frames).

1.2 Administrative Requirements

.1 Coordination:

.1 Cooperate fully with finish hardware distributor's representative during preparation of shop drawings and execution of shop fabrication.

.2 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.

.2 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Submit copy of NAAMM-HMMA 840-17 standard.

.3 *Product* data sheets:

.1 Submit manufacturer’s *Product* data sheets for *Products* proposed for use in the work of this section.

.4 Shop drawings:

.1 Include details of each door and frame type, finish hardware types and locations, frame profiles, door and frame elevations, mitre details, fire protection rating, glazing preparation details and anchor details and locations.

.2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.

.3 Electrified hardware requirements and preparations shall be clearly indicated on shop drawings.

1.4 Quality Assurance

.1 Qualifications:

.1 Manufacturers:

.1 *Provide* doors and frames manufactured by a firm specializing in the design and production of hollow metal steel doors and frames.

.2 Manufacturer shall be a member in good standing of the Canadian Steel Door Manufacturers Association (CSDMA).

1.5 Delivery, Storage, and Handling

.1 Inspect materials thoroughly upon receipt and report immediately discrepancies, deficiencies and damages, in writing, to *Supplier*.

.2 Note damages incurred during shipment on carriers' bill of lading and report immediately, in writing, to *Supplier*.

.3 Store materials properly on planks, out of water and covered to protect from damage from adverse weather conditions. Remove wet packaging immediately.

.4 Remove wrappings or coverings from doors upon receipt at the *Place of the Work*, and store in a vertical position, spaced with blocking to permit air circulation between them.

PART 2 - PRODUCTS

2.1 Manufacturers

.1 All Steel Doors 2000 Ltd.

.2 Apex Industries Inc.

.3 Artek Door (1985) Ltd.

.4 Daybar Industries Ltd.

.5 Fleming-Baron Door Products.

.6 M.J. Daley Manufacturing Co. Ltd.

.7 Trillium Steel Doors Limited.

.8 Vision Hollow Metal Limited.

2.2 Performance/Design Requirements

.1 Fire rating requirements:

.1 Fire rated labelled doors and frames: tested in accordance with CAN/ULC-S104-15 and listed by a nationally recognized agency having a factory inspection service and shall be constructed as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.2 Install fire labelled steel door and frame products in accordance with NFPA 80-2013, except where indicated otherwise.

.2 Doors and frames shall function as intended, including but not limited to:

.1 Be in true alignment.

.2 Operate and swing freely, smoothly, and easily.

.3 Remain stationary at any point.

.4 Close evenly and tightly against stops without binding.

.5 Latch positively when doors are closed with moderate force.

2.3 Materials

.1 Steel:

.1 Fabricated from tensioned levelled steel in accordance with ASTM A924/A924M-20, galvanized in accordance with ASTM A653/A653M-13, Commercial Steel CS, Type B.

.2 Steel shall be free of scale, pitting, coil breaks, surface blemishes, buckles, waves, and other defects.

.3 Minimum sheet thickness; uncoated steel sheet: in accordance with Appendix 1 of ANSI/NAAMM HMMA 861-14 “Guide Specifications for Commercial Hollow Metal Doors and Frames”.

.4 Finish: Minimum Galvanneal coating designation ZF120 (A40).

.2 Door core materials:

.1 Honeycomb: Structural small cell 25 mm (1") maximum kraft paper 'honeycomb'. Weight: 36.3 kg (80 lb) per ream (minimum). Density: 16.5 kg/m^3 (1.03 pcf) minimum, sanded to required thickness.

.3 Adhesives:

.1 Heat resistant, single component, polyurethane reactive (water) hot melt, thermoset adhesive.

.2 Lock seam doors: fire resistant, resin reinforced polychloroprene, high viscosity sealant-adhesive.

.4 Primer: rust inhibitive for touch-up.

.5 Finishing hardware: in accordance with Section 08 71 00.

.6 Miscellaneous:

.1 Door silencers: single stud rubber or neoprene type.

.2 Channel glazing stops and glazing trim: formed channel of minimum 0.81 mm (0.032”) (20 gauge) steel, 15.9 mm (5/8") high.

2.4 Fabrication - General

.1 Fabricate steel doors, frames, transoms, sidelights and borrowed lights as applicable, to the design and dimensions indicated. Take field measurements where coordination with adjoining work is necessary.

.2 Fabricate steel doors and frames to be rigid, neat in appearance and free from defects, warp, wave or buckle with all corners square unless otherwise indicated.

.3 Operating clearances:

.1 *Provide* clearance at floor with allowance made for indicated finish flooring materials.

.2 Clearances for Fire-Rated Doors: As required by NFPA 80-2013.

.3 Clearances for Non-Fire-Rated Doors: Not more than 3 mm (1/8") at jambs and heads, except not more than 6 mm (1/4") between pairs of doors. Not more than 19 mm (3/4") at bottom.

.4 Drill and tap or reinforce for mortised or surface mounted hardware in accordance with accepted hardware schedule, ANSI A115, NFPA 80-2013, or manufacturers recommendations.

.5 Countersink exposed fasteners unless otherwise shown. Use flat or oval head screws.

.6 Reinforce components to resist stresses imposed by hardware in use.

.7 Allow for anticipated expansion and contraction of frames and supports.

.8 Fit elements at intersections and joints accurately together, in true planes, and plumb and level.

.9 Perform welding in accordance with CSA W59-18.

.10 Mortise, reinforce, drill and tap to receive hardware and security devices using templates provided by respective *Supplier*.

.11 Touch up finish damaged during fabrication.

.12 Prepare doors or frames to receive seals where seals are indicated.

.13 Attach labels to suit required fire-protection and temperature rise ratings.

2.5 Fabrication - Steel Doors and Panels

.1 Fabricate steel doors and panels to a thickness of 45 mm (1-3/4"), unless indicated otherwise.

.2 Fire rated transom panels:

.1 Panel shall be installed at labelling facility as part of frame assembly; frame label shall cover both frame and panel assembly.

.3 Interior and non-insulated doors and panels:

.1 Face sheets fabricated from 1.06 mm (0.042") (18 gauge) steel.

.2 Honeycomb core.

.3 Longitudinal edges mechanically interlocked.

.1 Adhesive assisted with edge seams visible.

.4 Fabricate of composite metal face construction with each face formed from flush sheet steel without visible seams, free of scale, pitting, coil brakes, buckles and waves.

.5 Formed edges shall be true and straight with minimum radius for the thickness of steel used.

.6 Lock and hinge edges shall be bevelled 3 mm in 50 mm (1/8" in 2") unless hardware or door swing dictates otherwise.

.7 Top and bottom of doors shall be provided with inverted, recessed, 1.34 mm (0.053") (16 gauge) steel end channels, welded to each face sheet at 50 mm (2") on centre maximum.

.8 Prior to shipment, mark each door with an identification number as shown on the approved submittal drawings.

.9 Blank, reinforce, drill and tap doors for mortised, templated hardware. Locate hardware to manufacturer's standard unless indicated otherwise.

.10 Holes 12.7 mm (1/2") and larger shall be factory prepared.

.11 Glazing:

.1 For glazing materials greater than 8 mm (5/16") thick, doors shall receive 0.81 mm (0.032") (20 gauge) steel trim and screw fixed glazing stops. Screws shall be #6 x 32 mm (1-1/4") oval head Tek™ (self-drilling) type at 305 mm (12") on centre maximum.

.2 Glazing trim and stops shall be accurately fitted (within 0.39 mm (0.015”) tolerance), butted at corners, with removable glazing stops located on the 'push' side of the door.

.12 Fabricate closing stiles of paired doors as indicated or scheduled.

.13 Provide 2.36 mm (0.093") (12 gauge) 'flat' or 'Z' astragal at meeting stiles of pairs of doors for fire rating according to the manufacturers listing and as scheduled.

2.6 Fabrication - Steel Frames

.1 General: Applicable to frames, transom panel frames, sidelights, and window assemblies.

.2 Interior and non-thermally broken frames; welded:

.1 Fabricated from:

.1 1.34 mm (0.053") (16 gauge) steel.

.2 Supplied set-up and welded (SUW).

.3 Factory assembled frame product shall be square, free of defects, warps or buckles.

.4 Set-up and welded corner joints (SUW):

.1 Profile welded–punch mitred, continuously welded on inside of the profile faces, rabbets, returns and soffit intersections, with exposed faces filled and ground to a smooth, uniform seamless surface, as defined in the CSDMA - “Recommended Specifications for Commercial Steel Door and Frame Products”.

.5 Set-up and welded joints at mullions, sills and center rails:

.1 Coped accurately, butted and tightly fitted.

.2 At intersecting flush profile faces, securely weld, fill and grind to flush, smooth, uniform, seamless surface.

.3 At intersecting recessed profile faces, securely weld to concealed reinforcements, with exposed hairline face seams.

.4 At other intersecting profile elements make exposed face seams to hairline tolerance.

.6 Where required due to site access, when required for co-ordination or installation, or shipping limitations, frame product shall be fabricated in sections for splicing in the field.

.1 Field spliced jambs, heads and sills shall be provided with 1.34 mm (0.053") (16 gauge) steel splice plates securely welded into one section, extending 100 mm (4") minimum each side of splice joint.

.2 Field splices at closed sections (mullions or center rails) shall be 1.34 mm (0.053") (16 gauge) steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100 mm (4") minimum into closed sections when assembled.

.3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the installation company responsible for installation after assembly.

.7 On factory assembled frame product, provide 2 temporary steel shipping bars welded to the base of the jambs or mullions to maintain alignment during shipping and handling. Remove shipping bars prior to anchoring of frames to floor.

.8 Each door opening shall be prepared for single stud door silencers. Silencers shall be shipped loose for installation by installer, after finish painting.

.1 Single interior doors: 3 at strike jamb.

.2 Pair of interior doors: 2 at header.

.3 Sound, light, or smoke sealed doors: None required.

.4 Transom panels: 2 at each jamb.

.9 Prior to shipment, mark each frame with an identification number as shown on the approved submittal drawings.

.10 Provide mullions and transom bars of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.

.11 Conceal fastenings unless otherwise indicated.

.12 Anchor frames to floor by 1.34 mm (0.053") (16 gauge) thick angle clips, welded to frame and *Provide* with 2 holes for floor anchorage.

.13 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.

.14 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction.

.15 Reinforce head of frames wider than 1220 mm (48").

.16 Brace frame units to prevent distortion in shipment and protect finish.

.17 Fire rated transom panels:

.1 Secure panel in frame opening with minimum 19 mm (3/4") wide by 16 mm (5/8") high removable glazing stops, screw fastened.

2.7 Hardware Reinforcements and Preparations

.1 Door and frame product shall be blanked, reinforced, drilled and tapped at the factory for fully templated mortise hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier.

.2 Door and frame products shall be factory blanked and reinforced only for mortised hardware that is not fully templated.

.3 Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware are required frame product shall be reinforced only, with drilling and tapping done by field installation.

.4 Templated holes 12.7 mm (1/2") diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by installation on site. Templated holes less than 12.7 mm (1/2") diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.

.5 Hinge reinforcements shall be 3.12 mm (0.123") (10 gauge) steel minimum, high frequency type shall be provided.

.6 Frames shall be prepared for 114 mm (4.5”) standard weight hinges minimum unless otherwise indicated.

.7 Doors and frames in excess of 2450 mm (96") rabbet height shall be prepared for 114 mm (4.5”) heavy weight 4.6 mm (0.180”) hinges minimum.

.8 Lock, strike and flush bolt reinforcements shall be 1.34 mm (0.053") (16 gauge) steel minimum, with extruded tapped holes that provide equivalent number of threads as 2.36 mm (0.093") (12 gauge).

.9 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 1.06 mm (0.042") (18 gauge) steel minimum.

.10 Reinforcements are not required for surface applied hardware supplied with thru-bolts and spacers or sex-bolts.

.11 Provide hardware mortises on perimeter frame members to be grouted in masonry or concrete partitions with 0.66 mm (0.026") (22 gauge) steel grout guards.

2.8 Frame Anchorage

.1 Frame products shall be provided with anchorage appropriate to floor, wall and frame construction.

.2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb.

.3 Frame products for installation in new masonry walls shall be provided with steel adjustable wall anchors of the T-strap, stirrup or wire, 1.34 mm (0.053") (16 gauge) minimum or 3.96 mm (0.156”) diameter wire. Straps shall be not less than 50 mm (2") x 254 mm (10”) in size, corrugated and/or perforated.

.4 Frame products installed in steel stud and drywall partitions shall be provided with 0.81 mm (0.032") (20 gauge) steel snap-in or "Z" stud type anchors.

.5 Jambs of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4 mm (1/4") diameter, located not more than 150 mm (6") from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcing and directly opposite on the strike jamb. Each preparation shall be provided with 1.34 mm (0.053") (16 gauge) anchor bolt guides.

.6 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the installation company.

.7 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 1.34 mm (0.053") (16 gauge) steel floor anchors. Each anchor shall be provided with 2 holes for mounting to the floor and shall be securely welded to the inside of the jamb profile.

.8 On sidelights or windows exceeding 3 m (9'-10") in width, installed in stud partitions, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 2.36 mm (0.093") (12 gauge) steel formed channels, mounting angles and adjusting brackets, with mounting angles welded to the inside of frame head. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.

2.9 Sizes and Tolerances

.1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of ± 1.6 mm (+0.063").

.2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of ± 1.2 mm (± 0.047").

.3 Unless finishing hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3 mm (1/8") clearance at jambs and head. A clearance of 19 mm (3/4") between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be ± 1.2 mm (± 0.047").

.4 Manufacturing tolerances on formed frame profiles shall be ± 0.8 mm (± 0.031") for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbets shall be ± 1.6 mm (± 0.063") and ± 0.4 mm (± 0.016") respectively. Hardware cut-out dimensions shall be as per template dimensions, ±0.4 mm (+0.015").

2.10 Hardware Locations

.1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in paragraph 2.9 of this section.

.2 Top of upper hinge preparation for 114.3 mm (4.5") hinges shall be located 180 mm (7.5") down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3 mm (4.5") hinges shall be located 310 mm (12.625") from finished floor as defined in paragraph 2.9 of this section. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts.

.3 Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033 mm (40-5/16") from finished floor. Strikes for deadlocks shall be centered at 1220 mm (48") from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.

.4 Push and/or pulls on doors shall be centered 1070 mm (42") from finished floor.

.5 Preparations not noted above shall be as per hardware manufacturer's templates.

.6 Hardware preparation tolerances shall comply with the ANSI A115 standards.

PART 3 - EXECUTION

3.1 Examination

.1 *Provide* necessary grounds, bracing and strapping for fitting and adequate for securing of the work.

.2 Cooperate with work of other sections to ensure fastenings set by others are provided and located, their work is installed to their specifications and that those responsible for back priming are notified in sufficient time for them to schedule work.

3.2 Installation - Steel Doors and Frames

.1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-1708 11 13.

.2 Fire labelled product shall be installed in accordance with NFPA 80-2013.

.3 Frame product installation tolerances:

.1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be ±1.6 mm (±1/16").

.2 Squareness tolerance, measured through a line 90° from one jamb at the upper corner of the product, to the opposite jamb, shall be ±1.6 mm (±1/16").

.3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be ±1.6 mm (±1/16").

.4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be ±1.6 mm (±1/16").

.4 Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install temporary wood spreaders at mid-point of frame rabbet height to maintain frame widths. Remove wood spreaders after product has been built-in.

.5 Provide vertical support at center of head for openings exceeding 1250 mm (48") in width.

.6 Secure anchorages and connections to adjacent construction.

.7 Adjust operable parts for correct clearances and function.

.8 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.

.9 Remove grout or other bonding material from products immediately following installation.

.10 *Provide* appropriate anchorage for floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike jamb. On each jamb, install 2 anchors for openings up to and including 1525 mm (60") high and install 1 anchor for each additional height of 760 mm (30") of height or fraction thereof, except as indicated below. Frames placed in previously placed concrete, masonry or structural steel shall be *Provided* with anchors located not more than 150 mm (6") from top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum.

.11 Secure frames set in previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee wall anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.

.12 Fill and grind smooth “punch and dimpled” frame installations.

.13 Prior to site touch-up, exposed surfaces of galvanneal steel to be finished shall be cleaned to remove foreign matter. Refer to paint manufacturers recommendations for additional information and requirements of Section 09 91 00.

.14 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.

.15 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.

.16 Finish paint in accordance with Section 09 91 00.

.17 Install door silencers.

.18 Properly fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.

.19 Make allowance for deflection to ensure structural loads are not transmitted to frames.

.20 Adjust operable parts for correct clearances and function.

3.3 Installation - Finishing Hardware

.1 Install finishing hardware in accordance with ANSI A115.1G-1994, manufacturers' templates and instructions, and Section 08 71 00.

3.4 Adjusting and Cleaning

.1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by *Supplier's* requirements.

.3 Adjust doors equipped with closers to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location, and traffic.

.4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Solid core doors with high pressure plastic laminate (hinged and sliding doors).

.2 Factory finishing wood doors.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate installation of doors with installation of frames specified in other Sections and hardware specified in Section 08 71 00.

.2 Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Certification:

.1 Submit test reports or certification of compliance that manufacturer's doors have been tested and third party certified to meet or exceed performance duty level for door construction specified.

.4 Shop drawings:

.1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.

.2 Indicate door location using numbering system per door schedule, size, and hand of each door, elevation of each door type; undercuts, bevelling, construction type core and edge construction not covered in product data; and special blocking requirements.

.3 Indicate dimensions and locations of factory machining criteria for hardware, extent of hardware blocking.

.4 Indicate dimensions and locations of cut-outs including trim for openings.

.5 Indicate door face finish requirements including veneer matching.

.6 Indicate doors to be factory finished and finish requirements.

.5 Selection samples:

.1 Submit 3 sets of samples for initial selection purposes of actual veneers showing full range of grain variation, colour and matching, natural characteristics reflecting wood cut and species, manufacturing characteristics for each wood specifies specified. Submit samples as many times as required until approved by *Consultant*. First submission to include one set of samples per *Consultant* request plus one set lighter in tone and one set darker in tone.

.6 Verification samples:

.1 Submit samples of proposed plastic laminate door faces for each colour, texture and pattern selected.

.2 Submit cut-away sample of each type of door, to show stile and rail construction, core, cross banding, door face finish and edges.

1.4 Quality Assurance

.1 Qualifications:

.1 Manufacturer shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.

.2 Quality standard:

.1 Work shall be in accordance with the North American Architectural Woodwork Standards 4.0, Custom Grade.

1.5 Delivery, Storage, and Handling

.1 Doors shall be marked with door numbers used on shop drawings in the top hinge cavity created by the machining for hinges.

.2 Identify doors with labels. Package with resilient packaging.

.3 Store doors flat at the *Place of the Work* in piles with bottom face on bottom of pile. Protect from moisture by placing water resistant material under skids supporting piles. Cover top of piles and provide air at sides of piles.

.4 Deliver the wood doors only after the building is closed and dry and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period. Do not receive the doors in a damp area. Do not drag the doors on the ground, floor or across one another.

1.6 Field Conditions

.1 Environmental conditions:

.1 During storage and installation: Obtain and comply with wood door manufacturer’s instructions for optimum temperature and relative humidity conditions for wood doors during its storage and installation. Do not install wood doors until these conditions have been attained.

.2 During finishing: Comply with wood door manufacturer’s temperature and humidity requirements before, during, and after application of finishes.

.3 During service life of woodwork: Obtain and comply with wood door manufacturer's advice for optimum temperature and humidity conditions.

PART 2 - PRODUCTS

2.1 Manufacturers

.1 Baillargeon by Masonite Architectural.

.2 Lambton Doors.

.3 Masonite Architectural.

.4 VT Industries.

.5 Substitutions: in accordance with Section 01 25 00.

2.2 Performance/Design Requirements

.1 Flush wood doors shall meet the minimum acceptance levels in accordance with the North American Architectural Woodwork Standards 4.0.

.2 Doors and frames shall function as intended, including but not limited to:

.1 Be in true alignment.

.2 Operate and swing freely, smoothly, and easily.

.3 Remain stationary at any point.

.4 Close evenly and tightly against stops without binding.

.5 Latch positively when doors are closed with moderate force.

.6 No delamination.

.7 No telegraphing of core construction in face panels exceeding 0.254 mm (0.01") in a 75 mm (3") span, and warp exceeding 3 mm (1/8") in a 1066 mm (42") x 2133 mm (84") section.

2.3 General

.1 Single-source manufacturing and fabrication responsibility: Engage a qualified Manufacturer to assume undivided responsibility for wood doors specified in this section, including fabrication and finishing except where site finishing is specified.

2.4 Door Construction

.1 Door construction, industry abbreviations and types to North American Architectural Woodwork Standards 4.0.

.2 Performance duty level:

.1 Doors shall meet the requirements of ANSI/WDMA I.S. 1A-13 for Extra Heavy Duty Performance Level unless otherwise indicated or scheduled.

.3 Solid particle board core, high pressure decorative laminate faced, non fire rated wood door construction:

.1 Type PC-HPDL-5, particle core to ANSI A208.1-2009 LD-2.

.4 Bonding:

.1 Bond stiles and rails to core; abrasive sand core assembly to achieve uniform thickness prior to lamination of door faces.

.5 Panel edge types:

.1 High pressure decorative laminate faced doors:

.1 For vertical edges (stiles) and exposed horizontal edges (rails). (Exposed horizontal edges are those edges that can be viewed from floors above.):

.1 Edgeband: to later selection by the *Consultant*.

.2 For unexposed horizontal edges (rails):

.1 Non rated: Minimum 25 mm (1") structural composite lumber.

.6 Blocking:

.1 *Provide* hardware blocking for doors as follows:

.1 Non-rated doors: Structural composite lumber for hardware blocking.

.2 HB-1, minimum 125 mm (5") wide, full door width, top-rail blocking for closure devices or flush bolts or for sliding door hardware.

.3 HB-2, minimum 125 mm (5") wide, full door width, bottom-rail blocking for doors with protection plates, concealed door seals, automatic bottoms, pivots or floor bolts.

.4 HB-4, minimum 125 mm (5") wide x 250 mm (10") high blocking for doors with mortise locks and pockets.

.5 HB-5, minimum 125 mm (5") wide x 250 mm (10") high blocking for hinges.

.6 HB-6, minimum 125 mm (5") wide, full door width, mid-rail blocking for fire exit devices.

.7 HB-7, minimum 125 mm (5") wide, full door height, for doors with continuous type hinges.

.7 Thickness:

.1 45 mm (1-3/4") minimum unless otherwise indicated or scheduled.

.8 Sound Transmission Class (STC): doors indicated with an STC rating shall be in accordance with ASTM E90-09. Unless otherwise indicated, accessories required for acoustical rating compliance shall be *Provided* by door manufacturer; accessories to approval by *Consultant*.

.1 STC rating: refer to Door Schedule.

2.5 Plastic Laminate Faced Doors

.1 Type: Grade 10 General Purpose, to ANSI/NEMA LD3-2005.

.2 For acceptable *Product* and colour, refer to Material Legend.

2.6 Accessories

.1 Wood glass stops: Solid hardwood, species to match face finish, and referenced quality standard.

.2 Finishing hardware: in accordance with Section 08 71 00.

2.7 Fabrication

.1 Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

.1 Clearances: Refer to Part 3 for clearance tolerances.

.2 Fit doors for automatic door bottoms.

.3 Bevel non-fire-rated doors 3-1/2 degrees (1/8 inch in 2 inches) at lock and hinge edges.

.2 Fabricate doors with hardware blocking as specified in Part 2 of this Section.

.3 Factory machine doors for finish hardware that is not surface applied. Do not machine for surface hardware. Locate hardware to comply with Door and Hardware Institute (DHI) “Recommended Locations for Architectural Hardware for Flush Wood Doors (latest edition). Comply with final reviewed hardware schedules, door and frame shop drawings and hardware templates.

.4 Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes.

.5 Factory cut and trim openings.

.6 Transom and side panels:

.1 Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

2.8 Factory Finishing

.1 Finish work in factory in accordance with North American Architectural Woodwork Standards 4.0 and referenced quality standard.

.2 Prior to finishing, handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish. Sanding shall be completed just prior to stain or finishing application.

.3 Seal top and bottom door edges.

.4 Painted finish; exposed panel edge at plastic laminate faced doors: by Section 09 91 00.

PART 3 - EXECUTION

3.1 Examination

.1 *Provide* necessary grounds, bracing and strapping for fitting and adequate for securing of the work.

3.2 Installation - General

.1 Execute installation and assembly at the *Place of the Work* using skilled forces under supervision of a competent joinery foreperson.

.2 Install work plumb, level and straight, and fasten it securely to backing to support itself and anticipated superimposed loads.

.3 Build into construction as indicated, or specified in other sections of this specification, or both.

.4 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.

3.3 Installation - Doors

.1 Align and fit doors in frames with uniform clearances as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

.1 Clearances:

.1 Provide clearances as follows except where more stringent clearance is required or indicated.

.2 Provide 3.18 mm (1/8") maximum clearance between door and frame at heads, jambs, and between pairs of doors.

.3 Provide minimum 6 mm (1/4”) clearance from bottom of door and top of floor finish and maximum clearance of 9.5 mm (3/8”).

.2 Seal top and bottom edges of wood doors if they are cut to fit, in accordance with door manufacturer’s warranty requirements.

.3 Pilot drill screw and bolt holes.

3.4 Installation - Finishing Hardware

.1 Install finishing hardware in accordance with Section 08 71 00.

3.5 Adjusting and Cleaning

.1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by *Supplier's* requirements.

.3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.

.4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Supply and off-load to place in a clean, dry, and secure room at the *Place of the Work*, which has been designated for storage of all finish hardware specified including necessary fastening devices.

.2 Supply all finish hardware required and not supplied under other Sections.

.3 Check and verify hardware information on door and frame shop drawings, prior to fabrication.

.4 Packaging, labelling, provision of installation instructions, templates, fixings and similar items, and delivery to the *Work* site.

.5 Give assistance at the *Place of the Work* to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.

.6 Provide qualified staff at the *Place of the Work* promptly to assist installation trades subsequent to being requested and to ensure that hardware is being correctly installed.

.7 Upon completion of installation of hardware, hardware *Supplier* shall arrange and conduct, in company of *Consultant* and *Contractor*, inspections to verify that all hardware is installed and functioning satisfactorily, and where necessary shall recommend adjustments of such items as closer arms, valves, door holders and latch and locksets. Report comments in writing to *Consultant* and *Contractor*.

.8 Supply temporary locking cylinders and keys for construction purposes. Locks used for *Contractor's* security shall be keyed as required to conform to building operations' security requirements.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate work of this section to ensure information and material is promptly provided, to ensure orderly and expeditious progress of the *Work*, and to comply with schedule for completion.

.2 Within 3 weeks of *Contract* Award, submit confirmed orders to manufacturers/*Suppliers* to *Consultant*.

.3 Assist *Contractor* to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.

.4 Coordinate the work of this section to ensure supplied hardware can function as required and can be installed within the particular details of the door and frame assemblies. Hardware that cannot be installed or will not function as intended will be replaced at no cost to the *Owner*.

.2 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Schedules and samples:

.1 Prepare and submit for review, a finish hardware schedule for use in the *Work*. List type, selected manufacturer's name and number, location, mounting heights and finish of hardware, and complete cross reference to door schedule.

.2 The indication or omission of a hardware component on the hardware schedule does not remove the responsibility of this section to ensure that all hardware can be installed and will function as intended.

.3 Submit samples of complete line of hardware and finishes. Identify samples indicating hardware item numbers used in the Finish Hardware Schedule, manufacturer's numbers, names, types, finishes, sizes and indication of door location(s). Approved samples will be retained for comparisons and returned upon completion of the *Work*.

.4 Prepare and submit for review, a keying schedule recognizing *Owner* requirements which shall be determined after award of *Contract*.

.4 Templates:

.1 Submit for distribution, 3 copies of templates, template information, installation instructions and details necessary to enable preparation for, and installation of finish hardware in accordance with Door Hardware Institute recommended procedures. Submit templates arranged and marked coincident with specified hardware designations.

.2 Submit promptly when requested, the foregoing information in 3-ring plastic hard-covered binders suitably identified.

.3 In lieu of 1.3.4.1 arrange for the issue by each hardware manufacturer, the manufacturer's standard book of template drawings, at the option of door and frame manufacturers.

.5 Jigs:

.1 Submit template jigs for each component to be recessed to enable installation trades to prepare doors to preclude misalignment and improper fit.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Instruct the *Owner's* designated representative in proper care and preventative maintenance of hardware to assure longevity of operation.

.2 Submit maintenance data for cleaning and maintenance of finish hardware.

.3 Submit to building maintenance staff prior to date of *Substantial Performance*, two sets of wrenches for door closers, locksets and fire exit hardware.

1.5 Quality Assurance

.1 Qualifications:

.1 *Supplier*:

.1 Shall have 5 years' experience, minimum, in *Products*, systems and assemblies specified and with approval of *Product* manufacturers.

.2 Finish Hardware Supplier's project manager shall be directed involved in the day to day management of the project and shall be an accredited Architectural Hardware Consultant (AHC).

1.6 Delivery, Storage, and Handling

.1 Package each item of hardware individually, complete with trim and necessary fastenings, and accessories, including wrenches, keys, and other appurtenances required to ensure correct installation. Mark each item as to contents and appropriate use in specified groups.

.2 All items of hardware subject to handling when installed shall be submitted with an easily removable covering to protect against scratches, abrasions, coating with dissimilar finish materials on adjacent surfaces, and tarnishing.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Comply with codes and requirements of governing authorities, and as specified.

.2 *Provide* hardware items with characteristics to meet specified fire ratings, and conform to exit requirements of governing authorities.

2.2 Materials

.1 Finish hardware: in accordance with Finish Hardware Schedule.

PART 3 - EXECUTION

3.1 Examination

.1 Before furnishing any hardware, carefully check *Contract Documents*, verify door swings, door and frame materials and operating conditions, and assure that hardware will fit work to be attached.

.2 Check shop drawings and frame and door lists affecting hardware type and installation, and verify to correctness thereof, or advise of required revisions. Check that doors, frames and panels requiring additional support are reinforced.

.3 Point out special requirements to installer. Make final adjustment of hardware, in particular closer arms, valves and locksets, to work properly.

3.2 Installation

.1 Install in accordance with manufacturer's written installation requirements. Refer also to installation requirements indicated, and specified in other sections of specifications.

.2 Accurately locate and adjust hardware to meet manufacturer's written requirements. Use special tools and jigs as recommended.

.3 Locate door stops to contact doors 75 mm (3") from latch edge.

.4 Refer to Section 08 14 00 with respect to factory preparation for hardware for wood doors. Install wood doors and applicable hardware, including hinges.

.5 Take delivery of finishing hardware and install, except hardware specified as part of work of another section. Check each item as received.

.6 Set, fit and adjust hardware according to manufacturer's directions, at heights later directed by *Consultant*. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.

.7 Sound and weather seals:

.1 Install seals to continuously seal entire perimeter of doors. Secure in place with non-ferrous screws, in accurate alignment.

.2 Maintain integrity of seal at head of doors fitted with closers. Adapt seals as required to achieve specified performance.

.8 Pre-drill kickplates and doors prior to installation of kickplates. Apply with water-resistant adhesive and countersunk stainless steel screws.

.9 Set thresholds on two continuous beads of polyurethane caulking fastened with a minimum of 4 countersunk screws.

.10 At wood doors, use screw attachment for exit devices and closers.

3.3 Electrified Hardware

.1 Install electronic components, security components such as magnetic locks, sentronic hold open devices door status switches, card readers, processors, transformers, and other electric devices.

.2 Power wiring will be supplied and installed by Electrical Divisions 26, 27, and 28 including conduit, boxes and other electrical appurtenances, including connections and terminations. Be responsible for ensuring that all wiring work is done in accordance with the *Suppliers* wiring diagrams and directions.

.3 Arrange for testing and commissioning of system by the distributor of the system. Submit a copy of reports to the *Consultant*.

3.4 Keying

.1 Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

.2 Submit Construction Master Keying (CMK) and Grand Master Keying (GMK) upon completion of the work of this section.

3.5 Field Quality Control

.1 Field tests and inspections:

.1 Inspect the installation of finish hardware on an agreed frequency.

.2 Advise in writing of work being performed that will prejudice the installation or correct operation of items of hardware.

.3 Ensure items have been installed complete with required trim and accessories, and fastenings are adequately secured and approved. Ensure closer arms, valves, holder devices, locksets and latchsets are correctly adjusted.

.4 Inspections shall be performed by Finish Hardware Supplier's project manager involved in the day to day management of the project and shall be an accredited Architectural Hardware Consultant (AHC).

3.6 Adjusting and Cleaning

.1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by *Supplier's* requirements.

.3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.

.4 Clean hardware after installation in accordance with *Supplier's* requirements.

END OF SECTION

UTM Project
DV ERS/GGR/HCC Phase III Renovations

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Submittal Date: **April 20, 2023**

UTM Project
DV ERS/GGR/HCC Phase III Renovatins

Revision Dates:

Revised: Rev.1 - February 9, 2023 - Architects Revision (Feb 8, 2023)
Revised: Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)
Revised: Rev.3 - February 28, 2023 - Internal Revision
Revised: Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)
Revised: Rev.5 - April 14, 2023 - Owners Review (Apr 4, 4023)
Revised: Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)

Openings Schedule

Hardware Group	Qty	Opening Number(s)	Location 1	To/ From	Location 2	Hand	Door Type	Nominal Width	Nominal Height	Door Thickness	Door Mat'l	Frame Mat'l	Label	Remarks
001	1	1150K	CORRIDOR 1150K	FROM	EXISTING CORRIDOR	LHR/RHR	A/DJ1	965, 965	2150	45	HM	HM	45 MIN	
002	1	1152.1	CORRIDOR 1150K	FROM	WAITING AREA 1152	LHR/RHR	H/DJ1	965, 965	2150	45	WD	HM		
003	1	1152AA	DOOR DELETED									-	-	
004	1	1152A	WAITING AREA 1152	FROM	CRISIS ROOM 1152A	LHR	D/DJ1	965	2150	45	WD	HM		
005	1	1152.2	WAITING AREA 1152	FROM	CORRIDOR 1152K	LHR	D/DJ1	1067	2150	45	WD	HM		
006	1	1152B.1	WAITING AREA 1152	FROM	RECEPTION 1152B	LHR	D/DJ1	965	2150	45	WD	HM		
007	1	1152B.2	RECEPTION 1152B	From	CORRIDOR 1152K	LHR	D/DJ1	965	2150	45	WD	HM		
008	1	1152C	RECEPTION 1152B	TO	OFFICE 1152C	LH	C/DJ1/2	965	2150	45	WD	HM		
009	1	1152D	CORRIDOR 1152K	TO	NURSING TREATMENT CLEAN RM AREA	RH	D/DJ1	1067	2150	45	WD	HM		
010	1	1152E	NURSING TREATMENT AREA	TO	NURSING/TREATMEI RM CLEAN 1152E	LH	D/DJ1	1067	2150	45	WD	HM		
011	1	1152F	CORRIDOR 1152K	TO	TREATMENT RM DIRTY 1152F	RH	D/DJ1	965	2150	45	WD	HM		
012	1	1152G	CORRIDOR 1152K	FROM	UNIVERSAL WASHROOM 1152G	RHR	G/DJ1	1067	2150	45	IHM	HM		
013	1	1152J	CORRIDOR 1152K	TO	WASHROOM 1 1152J	RH	G/DJ1	965	2150	45	IHM	HM		
013	1	1152H	CORRIDOR 1152K	TO	WASHROOM 2 1152H	LH	G/DJ1	965	2150	45	IHM	HM		
014	1	1152K	CORRIDOR 1155K	TO	CORRIDOR 1152K	RH	D/DJ1	965	2150	45	WD	HM		
015	1	1152M	CORRIDOR 1152K	TO	DOCTOR/EXAM RM 1152M	SLIDER	F/DJ3	1220	2150	45	WD	HM		
015	1	1152L	CORRIDOR 1152K	TO	LEAD NURSE OFFICE 1152L	SLIDER	F/DJ3	1220	2150	45	WD	HM		
016	1	1152R	CORRIDOR 1152K	TO	DOCTOR/EXAM RM 1152R	SLIDER	F/DJ3	1220	2150	45	WD	HM		
016	1	1152Q	CORRIDOR 1152K	TO	DOCTOR/EXAM RM 1152Q	SLIDER	F/DJ3	1220	2150	45	WD	HM		
016	1	1152P	CORRIDOR 1152K	TO	DOCTOR/EXAM RM 1152P	SLIDER	F/DJ3	1220	2150	45	WD	HM		
016	1	1152N	CORRIDOR 1152K	TO	DOCTOR/EXAM RM 1152N	SLIDER	F/DJ3	1220	2150	45	WD	HM		
017	1	1152S	CORRIDOR	TO	OFFICE ROOM 1152S	RH	C/DJ1/2	965	2150	45	WD	HM		
018	1	1153A	CORRIDOR 1155K	FROM	GIS RESEARCH LAB 1153A	RHR	B/DJ1	1067	2150	45	WD	HM		
019	1	1153B	CORRIDOR 1155K	TO	DIRECTORS OFFICE 1153B	LH	C/DJ1/2	965	2150	45	WD	HM		
020	1	1153C	CORRIDOR 1155K	TO	ASSISTANT'S OFFICE 1153C	RH	C/DJ1/2	965	2150	45	WD	HM		
021	1	1154	CORRIDOR 1155K	FROM	EQUIPMENT STORAGE 1154	RHR	E/DJ1	965	2150	45	HM	HM		

Hardware Schedule

Heading #001

1 Pair of doors 1150K, CORRIDOR 1150K FROM EXISTING CORRIDOR LHR/RHRA

Type: A/DJ1, 965, 965 x 2150 x 45 - HM DR x HM FR - 45 MIN

STC 45

6	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Exit Device	ED5400A 630 (L910ET/626) LHR 45 965 MELR W048	630
1	Exit Device	ED5400A 630 (L910ET/626) RHR 45 965 MELR W048	630
1	Auto Operator	SW200i x Pull Arm x 1 Door C28	C28
1	ADO Bracket	Custom Mounting Plate C28	C28
2	Touchless Switch	CM-331/42-SGLR	
1	Relay	CX-33	
1	Surface Closer	4040XP REGARM TB 689	689
1	Mounting Bracket	4040XP-18 689	689/AL
2	Overhead Door Stop	104S C32D (Set for 90 Deg)	C32D
2	Kick Plate	GSH 80A C32D (305 X 940) B4E STMS	C32D
1	Weatherstripping	W-22-BL x 20'-4"	BL
2	Auto Door Bottom	CT-54 x 965mm c/w Shim	
1	Astragal	W-5S x 2150	
1	Threshold	14/1A x 50mm x 1930mm	A
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	120v Power	120v Power For ADO - By Electrical	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

NOTE:
- AUTO DOOR OPERATOR SUPPLIED AND INSTALLED BY THIS SECTION.
- INTEGRATION, TERMINATION AND COMMISSIONING OF AUTO DOOR OPERATOR BY THIS SECTION.
- ALL 110V WIRING, CONDUIT, JUNCTION BOXES AND PULL STRINGS SUPPLIED AND INSTALLED BY DIV. 26.
- ALL 110V WIRING, PULLED AND TERMINATED BY DIV. 26.
- ALL LV WIRING SUPPLIED AND INSTALLED FOR ADO AND RELATED COMPONENTS BY DIV. 26.

Heading #002

1 Pair of doors 1152.1, CORRIDOR 1150K FROM WAITING AREA 1152 LHR/RHRA

Type: H/DJ1, 965, 965 x 2150 x 45 - WD DR x HM FR

STC45/1930 X 490 TRANSOM

6	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Exit Device	ED5400 630 (L959ET/626) L9 Lustra LHR 45 965 MELR W048	630
1	Exit Device	ED5400 630 (L959ET/626) L9 Lustra RHR 45 965 MELR W048	630
2	Rim Cylinder	31-0375H-24-Y02 626	626
2	Const. Core	Black Construction Core	Black
2	Cylinder Core	Cylinder Core - By UTM	
2	Cylinder Ring	CP-180021 626	626
2	Power Transfer	EPT-10-689- CON	689
2	Wire Harness	CON-12P	
2	Wire Harness	CON-192P	
1	Power Supply	BPS-24-2 x CFAR	
1	Motion Sensor	REX Motion Sensor - By Security	
2	Door Contact	Door Contact - By Security	
1	Surface Closer	4040XP EDA x ST-3068 689	689
1	Bracket	4040XP-18G 689	689
2	Kick Plate	GSH 80A C32D (305 x 940) B4E WS	C32D
2	Overhead Door Stop	104S C32D (Set for 90 Deg)	C32D
1	Auto Operator	SW200i x Push Arm x 1 Door C28	C28
1	ADO Bracket	Custom Mounting Plate C28	C28
2	Touchless Switch	CM-331/42-SGLR	
1	Relay	CX-33	
1	Card Access	Card Access - By Security	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	Threshold	Threshold - By Others	
2	Door Bottom	434APKL x 965mm	
1	Weatherstripping	W-63-BL x 21'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	120v Power	120v Power For ADO - By Electrical	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

NOTE:
- AUTO DOOR OPERATOR SUPPLIED AND INSTALLED BY THIS SECTION.
- INTEGRATION, TERMINATION AND COMMISSIONING OF AUTO DOOR OPERATOR BY THIS SECTION.
- ALL 110V WIRING, CONDUIT, JUNCTION BOXES AND PULL STRINGS SUPPLIED AND INSTALLED BY DIV. 26.
- ALL 110V WIRING, PULLED AND TERMINATED BY DIV. 26.
- ALL LV WIRING SUPPLIED AND INSTALLED FOR ADO AND RELATED COMPONENTS BY DIV. 26.
- INTEGRATION OF ACCESS CONTROL SYSTEM WITH AUTO DOOR OPERATOR TO BE DONE BY THIS SECTION IN COOPERATION WITH SECURITY INTEGRATOR.
- VALID CARD TO BE PRESENTED TO ACTIVATE OUTSIDE BUTTON. INTERIOR BUTTON ALWAYS ACTIVE.
- CARD READER TO RETRACT BOTH EXIT DEVICES FOR FREE PASSAGE THROUGH EITHER DOOR DURING PUBLIC HOURS. AFTER HOURS CARD READER RETRACT DEVICE ONLY TO BEGIN OPENING CYCLE OF ADO.

Heading #003

1 Elevation 1152AA, DOOR DELETED

__ x __ x __ - HM DR x - FR - -

DOOR DELETED

Heading #004

1 Single door 1152A, WAITING AREA 1152 FROM CRISIS ROOM 1152A LHR

Type: D/DJ1, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Office Lockset	ML2051 LWA 630 LHR LC	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Surface Closer	4040XP EDA x ST-3068 689	689
1	Mounting Plate	4040XP-419 689	689
1	Bracket	4040XP-18G 689	689
1	Overhead Door Stop	105S C32D (Set for 90 Deg)	C32D
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Revised	Rev.3 - February 28, 2023 - Internal Revision	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #005

1 Single door 1152.2, WAITING AREA 1152 FROM CORRIDOR 1152K LHR

Type: D/DJ1, 1067 x 2150 x 45 - WD DR x HM FR

STC 45/1067 X 490 TRANSOM

3	Standard Hinge	TA786 5" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC LHR (Storeroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Electric Strike	2164 12/24V RH x 32D (Fail Secure)	32D
1	Card Access	Card Access - By Security	
1	Surface Closer	4040XP EDA x ST-3068 689	689
1	Mounting Plate	4040XP-419 689	689
1	Bracket	4040XP-18G 689	689
1	Overhead Door Stop	105S C32D (Set for 90 Deg)	C32D
1	Door Contact	Door Contact - By Security	
1	Motion Sensor	REX Motion Sensor - By Security	
1	Kick Plate	GSH 80A C32D (305 x 1025) B4E STMS	C32D
1	Door Bottom	434APKL x 1067	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.3 - February 28, 2023 - Internal Revision	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #006

1 Single door 1152B.1, WAITING AREA 1152 FROM RECEPTION 1152B LHR

Type: D/DJ1, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC LHR (Storeroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Electric Strike	2164 12/24V RH x 32D (Fail Secure)	32D
1	Card Access	Card Access - By Security	
1	Surface Closer	4040XP EDA x ST-3068 689	689
1	Bracket	4040XP-18G 689	689
1	Mounting Plate	4040XP-419 689	689
1	Overhead Door Stop	104S C32D (Set for 90 Deg)	C32D
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Door Contact	Door Contact - By Security	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Motion Sensor	REX Motion Sensor - By Security	
1	Central Power	Central Power - By Electrical	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.3 - February 28, 2023 - Internal Revision	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #007

1 Single door 1152B.2, RECEPTION 1152B From CORRIDOR 1152K LHR

Type: D/DJ1, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC LHR (Storeroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Card Access	Card Access - By Security	
1	Surface Closer	4040XP REGARM TB 689	689
1	Bracket	4040XP-18G 689	689
1	Overhead Door Stop	104S C32D (Set for 90 Deg)	C32D
1	Electric Strike	2164 12/24V RH x 32D (Fail Secure)	32D
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Door Contact	Door Contact - By Security	
1	Motion Sensor	REX Motion Sensor - By Security	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	Door Bottom	434APKL x 965mm	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Threshold	Threshold - By Others	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.3 - February 28, 2023 - Internal Revision	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

NOTE:
- CONFIRM LOCATION OF CARD READER PRIOR TO ORDERING DOOR.

Heading #008

1 Single door 1152C, RECEPTION 1152B TO OFFICE 1152C LH

Type: C/DJ1/2, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Office Lockset	ML2051 LWA 630 LH LC	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Floor Door Stop	GSH 209 C26D	C26D
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Door Bottom	434APKL x 965mm	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.3 - February 28, 2023 - Internal Revision	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #009

1 Single door 1152D, CORRIDOR 1152K TO NURSING TREATMENT CLEAN RM AREA RH

Type: D/DJ1, 1067 x 2150 x 45 - WD DR x HM FR

3	Standard Hinge	TA786 5" x 4" C26D NRP	C26D
1	Office Lockset	ML2051 LWA 630 RH LC	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Surface Closer	4041 CYLDEL REGARM 689	689
1	Bracket	4040XP-18G 689	689
1	Overhead Door Holder	105H C32D	C32D
1	Armor Plate	GSH 80A C32D (864 x 1025) B4E WS	C32D
1	Door Bottom	434APKL x 1067	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.5 - April 14, 2023 - Owners Review (Apr 4, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #010

1 Single door 1152E, NURSING TREATMENT AREA TO NURSING/TREATMENT RM CLEAN 1152E LH

Type: D/DJ1, 1067 x 2150 x 45 - WD DR x HM FR

STC 45

3	Standard Hinge	TA786 5" x 4" C26D NRP	C26D
1	Latchset	ML2010 LWA 630 LH	630
1	Surface Closer	4041 CYLDEL REGARM 689	689
1	Bracket	4040XP-18G 689	689
1	Overhead Door Holder	105H C32D	C32D
1	Armor Plate	GSH 80A C32D (864 x 1025) B4E WS	C32D
1	Door Bottom	434APKL x 1067	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.5 - April 14, 2023 - Owners Review (Apr 4, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #011

1 Single door 1152F, CORRIDOR 1152K TO TREATMENT RM DIRTY 1152F RH

Type: D/DJ1, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Lockset	ML2055 LWA 630 LC RH (Classroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Overhead Door Holder	104H C32D	C32D
1	Armor Plate	GSH 80A C32D (864 x 925) B4E STMS	C32D
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.5 - April 14, 2023 - Owners Review (Apr 4, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #012

1 Single door 1152G, CORRIDOR 1152K FROM UNIVERSAL WASHROOM 1152G RHR

Type: G/DJ1, 1067 x 2150 x 45 - IHM DR x HM FR

STC 45

3	Standard Hinge	TA786 5" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC RHR (Storeroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Electric Strike	2364 (Fail Safe) LH x 24VDC C32D	C32D
1	Auto Operator	SW200i x Push Arm x 1 Door C28	C28
1	BF Washroom Control Kit	CX-WC16 630	630
1	Washroom Control Kit	CX-WEC10BK2	
1	Door Contact	1078B BRN	BRN
1	Overhead Door Stop	105S C32D (Set for 90 Deg)	C32D
1	Kick Plate	GSH 80A C32D (305 x 1025) B4E STMS	C32D
1	Threshold	Threshold - By Others	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Central Power	Central Power - By Electrical	
1	120v Power	120v Power For ADO - By Electrical	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

NOTE:
- AUTO DOOR OPERATOR SUPPLIED AND INSTALLED BY THIS SECTION.
- INTEGRATION, TERMINATION AND COMMISSIONING OF AUTO DOOR OPERATOR BY THIS SECTION.
- ALL 110V WIRING, CONDUIT, JUNCTION BOXES AND PULL STRINGS SUPPLIED AND INSTALLED BY DIV. 26.
- ALL 110V WIRING, PULLED AND TERMINATED BY DIV. 26.
- ALL LV WIRING SUPPLIED AND INSTALLED FOR ADO AND RELATED COMPONENTS BY DIV. 26.

Heading #013

1 Single door 1152J, CORRIDOR 1152K TO WASHROOM 1 1152J	RH
1 Single door 1152H, CORRIDOR 1152K TO WASHROOM 2 1152H	LH

Type: G/DJ1, 965 x 2150 x 45 - IHM DR x HM FR

STC 45

6	Standard Hinge	TA386 4 1/2" x 4" C32D	C32D
1	Lockset	ML2060 LWA 630 LH M19VN EMB	630
1	Lockset	ML2060 LWA 630 RH M19VN EMB	630
2	Surface Closer	1461 CYLDEL RWPA 689 FPC	689
2	Mounting Plate	1460-18FC 689	689
2	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
2	Overhead Door Stop	104S C32D (Set for 90 Deg)	C32D
2	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
2	Weatherstripping	W-63-BL x 20'0"	BL
2	Auto Door Bottom	CT-54 x 965mm c/w Shim	
2	Threshold	Threshold - By Others	
2	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
2	Revised	Rev.5 - April 14, 2023 - Owners Review (Apr 4, 2023)	
2	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #014

1 Single door 1152K, CORRIDOR 1155K TO CORRIDOR 1152K RH

Type: D/DJ1, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC RH (Storeroom)	630
1	Electric Strike	2164 12/24V RH x 32D (Fail Secure)	32D
1	Auto Operator	SW200i x Pull Arm x 1 Door C28	C28
1	ADO Bracket	Custom Mounting Plate C28	C28
2	Touchless Switch	CM-331/42-SGLR	
1	Relay	CX-33	
1	Overhead Door Stop	104S C32D (Set for 90 Deg)	C32D
1	Door Contact	Door Contact - By Security	
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Door Bottom	434APKL x 965mm	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	120v Power	120v Power For ADO - By Electrical	
1	Threshold	Threshold - By Others	
1	Card Access	Card Access - By Security	
1	Motion Sensor	REX Motion Sensor - By Security	
1	Revised	Rev.1 - February 9, 2023 - Architects Revision (Feb 8, 2023)	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.5 - April 14, 2023 - Owners Review (Apr 4, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

NOTE:
- AUTO DOOR OPERATOR SUPPLIED AND INSTALLED BY THIS SECTION.
- INTEGRATION, TERMINATION AND COMMISSIONING OF AUTO DOOR OPERATOR BY THIS SECTION.
- ALL 110V WIRING, CONDUIT, JUNCTION BOXES AND PULL STRINGS SUPPLIED AND INSTALLED BY DIV. 26.
- ALL 110V WIRING, PULLED AND TERMINATED BY DIV. 26.
- ALL LV WIRING SUPPLIED AND INSTALLED FOR ADO AND RELATED COMPONENTS BY DIV. 26.
- INTEGRATION OF ACCESS CONTROL SYSTEM WITH AUTO DOOR OPERATOR TO BE DONE BY THIS SECTION IN COOPERATION WITH SECURITY INTEGRATOR.
- VALID CARD TO BE PRESENTED TO ACTIVATE OUTSIDE BUTTON. INTERIOR BUTTON ALWAYS ACTIVE.

Heading #015

1 Single door 1152M, CORRIDOR 1152K TO DOCTOR/EXAM RM 1152M	SLIDER
1 Single door 1152L, CORRIDOR 1152K TO LEAD NURSE OFFICE 1152L	SLIDER

Type: F/DJ3, 1220 x 2150 x 45 - WD DR x HM FR

STC 45/SLIDING DOOR

2	Track Assembly	CCSF-998 x Door Opening Width	
2	Strike Cover	C-CWS-1750-Cover x Door Height	
2	Door Pull	GSH 167F x GSH 167F x 610mm #5 Mtg C32D	C32D
2	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	

Heading #016

1 Single door 1152R, CORRIDOR 1152K TO DOCTOR/EXAM RM 1152R	SLIDER
1 Single door 1152Q, CORRIDOR 1152K TO DOCTOR/EXAM RM 1152Q	SLIDER
1 Single door 1152P, CORRIDOR 1152K TO DOCTOR/EXAM RM 1152P	SLIDER
1 Single door 1152N, CORRIDOR 1152K TO DOCTOR/EXAM RM 1152N	SLIDER

Type: F/DJ3, 1220 x 2150 x 45 - WD DR x HM FR

STC 45/SLIDING DOOR

4	Track Assembly	CCSF-998 x Door Opening Width	
4	Strike Cover	C-CWS-1750-Cover x Door Height	
4	Door Pull	GSH 167F x GSH 167F x 610mm #5 Mtg C32D	C32D

Heading #017

1 Single door 1152S, CORRIDOR TO OFFICE ROOM 1152S RH

Type: C/DJ1/2, 965 x 2150 x 45 - WD DR x HM FR

STC 45

3	Standard Hinge	TA786 4 1/2" x 4" C26D	C26D
1	Office Lockset	ML2051 LWA 630 RH LC	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Floor Door Stop	GSH 209 C26D	C26D
1	Door Bottom	434APKL x 965mm	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #018

1 Single door 1153A, CORRIDOR 1155K FROM GIS RESEARCH LAB 1153A RHR

Type: B/DJ1, 1067 x 2150 x 45 - WD DR x HM FR

STC45/1067 X 490 TRANSOM

3	Standard Hinge	TA786 5" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC RHR (Storeroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Electric Strike	2164 12/24V LH x 32D (Fail Secure)	32D
1	Card Access	Card Access - By Security	
1	Auto Operator	SW200i x Push Arm x 1 Door C28	C28
1	ADO Bracket	Custom Mounting Plate C28	C28
1	Relay	CX-33	
2	Touchless Switch	CM-331/42-SGLR	
1	120v Power	120v Power For ADO - By Electrical	
1	Overhead Door Stop	105S C32D (Set for 90 Deg)	C32D
1	Kick Plate	GSH 80A C32D (305 x 1025) B4E WS	C32D
1	Door Bottom	434APKL x 1067	
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Threshold	Threshold - By Others	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	Motion Sensor	REX Motion Sensor - By Security	
1	Door Contact	Door Contact - By Security	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.5 - April 14, 2023 - Owners Review (Apr 4, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

NOTE:
- AUTO DOOR OPERATOR SUPPLIED AND INSTALLED BY THIS SECTION.
- INTEGRATION, TERMINATION AND COMMISSIONING OF AUTO DOOR OPERATOR BY THIS SECTION.
- ALL 110V WIRING, CONDUIT, JUNCTION BOXES AND PULL STRINGS SUPPLIED AND INSTALLED BY DIV. 26.
- ALL 110V WIRING, PULLED AND TERMINATED BY DIV. 26.
- ALL LV WIRING SUPPLIED AND INSTALLED FOR ADO AND RELATED COMPONENTS BY DIV. 26.
- INTEGRATION OF ACCESS CONTROL SYSTEM WITH AUTO DOOR OPERATOR TO BE DONE BY THIS SECTION IN COOPERATION WITH SECURITY INTEGRATOR.
- VALID CARD TO BE PRESENTED TO ACTIVATE OUTSIDE BUTTON. INTERIOR BUTTON ALWAYS ACTIVE.

Heading #019

1 Single door 1153B, CORRIDOR 1155K TO DIRECTORS OFFICE 1153B LH

Type: C/DJ1/2, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Office Lockset	ML2051 LWA 630 LH LC	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Floor Door Stop	GSH 209 C26D	C26D
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Door Bottom	434APKL x 965mm	
1	Threshold	Threshold - By Others	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #020

1 Single door 1153C, CORRIDOR 1155K TO ASSISTANT'S OFFICE 1153C RH

Type: C/DJ1/2, 965 x 2150 x 45 - WD DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Office Lockset	ML2051 LWA 630 RH LC	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Floor Door Stop	GSH 209 C26D	C26D
1	Kick Plate	GSH 80A C32D (305 x 925) B4E WS	C32D
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Perimeter Sound Seal	Perimeter Sound Seal - By Opening Supplier	
1	Door Bottom	434APKL x 965mm	
1	Threshold	Threshold - By Others	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	
1	Revised	Rev.6 - April 19, 2023 - Architects Revision (Apr 18, 2023)	

Heading #021

1 Single door 1154, CORRIDOR 1155K FROM EQUIPMENT STORAGE 1154 RHR

Type: E/DJ1, 965 x 2150 x 45 - HM DR x HM FR

STC 45/965 X 490 TRANSOM

3	Standard Hinge	TA786 4 1/2" x 4" C26D NRP	C26D
1	Lockset	ML2057 LWA 630 LC RHR (Storeroom)	630
1	Mortise Cylinder	31-0175 C26D x CT-Z00	C26D
1	Const. Core	Black Construction Core	Black
1	Cylinder Core	Cylinder Core - By UTM	
1	Cylinder Ring	CP-180021 626	626
1	Electric Strike	2164 12/24V LH x 32D (Fail Secure)	32D
1	Surface Closer	4040XP EDA x ST-3068 689	689
1	Bracket	4040XP-18G 689	689
1	Mounting Plate	4040XP-419 689	689
1	Armor Plate	GSH 80A C32D (864 x 925) B4E STMS	C32D
1	Threshold	14/1A x 50mm x 965mm	A
1	Weatherstripping	W-63-BL x 20'0"	BL
1	Auto Door Bottom	CT-54 x 965mm c/w Shim	
1	Card Access	Card Access - By Security	
1	Door Contact	Door Contact - By Security	
1	Motion Sensor	REX Motion Sensor - By Security	
1	Wire Diagram	Point To Point Wiring Diagram	
1	Opening Schematic Diagram	Opening Schematic Diagram	
1	Central Power	Central Power - By Electrical	
1	Revised	Rev.2 - February 21, 2023 - Architects Revision (Feb 17, 2023)	
1	Revised	Rev.4 - March 23, 2023 - Owners Review (Mar 15, 2023)	

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Glass and glazing (GL-1, GL-3, and GL-5).

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.

.2 For glass scheduled or indicated as engineered and glass to serve as guards in accordance with building code, shop drawings to be engineered shop drawings.

.4 Samples:

.1 Submit 305 mm (12") square samples of each type of glass indicated except for clear monolithic glass products, and 305 mm (12") long samples of each color required, except black, for each type of sealant or gasket exposed to view.

.1 Submit samples of glass showing each type of shape and finish of glass edge for exposed glass edges.

.2 Submit 305 mm (12") long samples of top, bottom, and vertical channels rails for glass wall panels in specified finish.

.5 Test and evaluation reports:

.1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.

.2 Submit valid independent laboratory test reports for the various glass and glazing assemblies in coordination with the specified aluminum framed glazing systems demonstrating compliance with specified acoustic performance values in accordance with recognized industry standards and specified performance requirement specified in this section.

.1 Test reports shall be recent and produced with the past 5 years.

.6 Manufacturer reports:

.1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.

.7 Submit sample glazing warranty.

.8 Submit letter from insulating glass unit fabricator that insulating glass units supplied will bear the certification mark of IGMAC or IGCC/IGMA.CAN/CGSB 12.8-97

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.5 Quality Assurance

.1 Qualifications:

.1 Manufacturers: Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002 1994.

.2 Installers / applicators / erectors: *Provide* the work of this section executed by specialist *Subcontractor* who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of the work of this section, and personally direct installation performed under this section.

.1 Foreperson experience: Shall have 10 years' experience, minimum, as glazing mechanic.

.2 Glazing mechanic experience: Shall have 3 years' experience, minimum, as glazers.

.3 Mirror installations: Installation only by applicator trained and approved by adhesive manufacturer for application of its products.

.2 Mock-ups:

.1 Provide mock-up of mirror installation, including minimum of 4 full size mirrors. Locate mirror mock-up where approved by *Consultant*.

1.6 Delivery, Storage, and Handling

.1 Protect glass from edge damage, dust, and contaminants during handling and storage. For insulating units exposed to substantial altitude changes, comply with insulating glass manufacturers written recommendations for venting and sealing to avoid hermetic seal ruptures.

.2 Storage and protection: Protect glazing materials according to manufacturer's written requirements and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.7 Field Conditions

.1 Ambient Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation or other causes.

.2 Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4°C (40°F).

1.8 Warranty

.1 Extended warranty:

.1 Labour, materials, and workmanship for work of this section.

.2 Duration: 10 years.

.3 For laminated glass products:

.1 Warranty shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer’s published instructions. Warranty shall be manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units.

.4 For tempered glass products:

.1 Warrant that tempered glass will not break spontaneously as a result of Nickel Sulfide (NiS) inclusions at a rate exceeding 0.8% (8/1000) for a period of five years from the date of manufacture. Warranty shall be manufacturer's standard form in which tempered-glass manufacturer agrees to replace tempered-glass units.

.5 For mirror glass products:

.1 Provide a written warranty from date of manufacture for mirror silvering. Warranty shall cover the following:

.1 Deterioration due to normal conditions of use and not to handling, installing, protecting and maintaining practices contrary to the glass manufacturer’s published instructions.

.2 Replacement of mirror glass units.

.3 Duration: 10 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 General:

.1 Publications: Comply with recommendations in the publications below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section.

.1 GANA Glazing Manual.

.2 GANA Engineering Standards Manual.

.3 GANA Laminated Glazing Reference Manual.

.4 GANA Sealant Manual.

.2 Regulatory requirements:

.3 Glass strength:

.1 Design glass in conformance with the building code and the following requirements:

.1 Minimum thickness of annealed or heat-treated glass products to be selected so the worst case probability of failure does not exceed the following:

.1 8 breaks per 1000 for glass installed vertically less than 15 degrees from the vertical plane and under wind action.

.2 Glass thicknesses and glass types specified, indicated, or scheduled in the *Contract Documents* are minimums required. Modify glass thickness as required to satisfy design and building code requirements, and requirements of authorities having jurisdiction, and any such modifications shall be clearly indicated on shop drawings.

.4 Protect laminated glass interlayer from damage or discolouration resulting from contact with deleterious and incompatible sealants, substances, and materials. Comply with manufacturer's recommended installation requirements.

2.2 Performance/Design Requirements - Acoustic

.1 Design glass and glazing units in conjunction with aluminum framed glazing systems and related assemblies to provide the indicated sound transmission class (STC) as indicated on the drawings when tested to ASTM E90-09.

2.3 Glass Manufacturers

.1 Subject to compliance with the requirements of the Contract Documents, provide primary glass by one of the following float glass manufacturers:

.1 Cardinal Glass Industries.

.2 Guardian Industries, LLC.

.3 Pilkington North America.

.4 Vitro Architectural Glass.

2.4 Glass Materials

.1 General:

.1 Single source responsibility: *Provide* materials from a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source and manufacturing plant for each type and class required.

.2 Annealed (float) glass:

.1 Clear, annealed glass, 6 mm (1/4") thick minimum, in accordance with CAN/CGSB 12.3-M91, Glazing Quality.

.1 Acceptable products:

.1 Cardinal.

.2 Guardian Industries.

.3 Pilkington.

.4 Vitro Architectural Glass.

.3 Heat treated (tempered or heat strengthened) float glass (GL-3):

.1 In accordance with CAN/CGSB 12.1-M90.

.2 Minimum thickness: as indicated on drawings.

.3 Fabrication process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

.4 For uncoated glass, comply with requirements for Condition A in accordance with ASTM C1048-18.

.5 For coated vision glass, comply with requirements for Condition C (other coated glass) in accordance with ASTM C1048-18.

.6 Heat strengthened glass shall have surface compression of 24-52 MPa (3,500-7,500 psi).

.7 Film applied to GL-2: in accordance with Section 08 87 00.

.4 Laminated (Security) glass (GL-1):

.1 In accordance with CAN/CGSB 12.1-M90.

.2 Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation.

.3 Minimum thickness: as indicated on drawings.

.4 Glass layers minimum 5 mm (0.197") thick unless otherwise indicated.

.5 Interlayer thickness: Provide thickness as needed to comply with requirements and not less than the following:

.1 Vertical glazing: not less than 0.76 mm (0.030") unless otherwise indicated.

.6 Interlayer colour: Clear unless otherwise indicated.

.7 Glass type: annealed or heat strengthened or tempered, as required to suit design requirements.

.8 Laminated glass products to be fabricated free of foreign substances and air or glass pockets in autoclave with heat plus pressure.

.5 Mirrors; transparent (GL-5):

.1 Annealed glass, to ASTM C1503-18 as follows:

.2 Grade: Mirror Cut Size.

.3 Quality: Mirror Select Quality, except allowable distortion shall be ≥ 80° vision interference angle in accordance with ASTM C1036-16 Table 5.

.4 Colour: Clear.

.5 Thickness: as indicated on drawings.

.6 Exposed edges shall be chamfered, ground, and polished.

2.5 Glazing Materials (Non-Fire Rated)

.1 Glazing materials; general: Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

.2 Glazing gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

.1 Preformed, EPDM to ASTM C864-05(2019).

.3 Aluminum glazing channels:

.1 Top and bottom channels: Satin anodized 12.7 mm (1/2") aluminum U-channel.

.1 Acceptable *Product*: CR Laurence DV750A.

.2 45 degree upright extrusion: Satin anodized 2.41 mm (0.095”) thick.

.1 Acceptable *Product*: CR Laurence D3117A.

.4 Setting blocks: Moulded or extruded material with Shore, Type A Durometer hardness of 85, plus or minus 5, made from one of the following:

.1 Preformed, EPDM to ASTM C864-05(2019).

.5 Spacers: Moulded or extruded blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated made from one of the following:

.1 Preformed, EPDM to ASTM C864-05(2019).

.6 Edge blocks: Moulded or extruded material of hardness needed to limit glass lateral movement (side walking) made from one of the following:

.1 Preformed, EPDM to ASTM C864-05(2019).

.7 Cleaners, primers and sealers: Type recommended by sealant or gasket manufacturer.

.8 Polyurethane foam glazing tape:

.1 High density, closed-cell, flexible, non-extruding tape, adhesive backed one side only; recommended by manufacturer for exterior applications with nominal pressure in glazing channel.

.2 Acceptable *Products*: As recommended by manufacturer suitable for conditions of application and use.

.9 Mirror clips:

.1 Nickel plated, CR Laurence ‘Vancouver’ clips.

.10 Mirror adhesive:

.1 Acceptable *Product*:

.1 Palmer ‘Mirro-Mastic’, complete with sealer as required.

.11 Butt glazing joint sealant:

.1 Medium-modulus, neutral-curing silicone sealant; complying with ASTM C920-11, Type S, Grade NS, Application G, Class 25.

.2 Colour: as selected by *Consultant* from full colour range.

.3 Acceptable *Products*:

.1 DOWSIL ‘999-A’.

.2 Momentive ‘SCS1200’.

.3 Pecora ‘860’.

.4 Tremco ‘Proglaze’.

2.6 Fabrication of Glazing Units

.1 Fabricate glazing units in sizes required to fit openings, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

.1 Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

.2 Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

.3 Grind smooth and chamfer, and polish exposed glass edges and corners, unless otherwise indicated.

PART 3 - EXECUTION

3.1 Examination

.1 Examine framing, glazing channels, and stops, with glazing installer present, for compliance with the following:

.1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

.2 Inspect butt and mitre joints in framing. Seal joints found to be open with a compatible sealant prior to glazing.

.3 Glazing pockets and surfaces are free of dust, construction debris, and contaminants.

.4 Presence and functioning of weep systems.

.5 Minimum required face and edge clearances as per FGIA and GANA standards.

.6 Effective sealing between joints of glass-framing members.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

.1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

.2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

.3 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's requirements. Ensure surfaces are free of moisture and frost.

3.3 Glazing - General

.1 Comply with combined written requirements of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

.2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

.3 Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

.4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.

.5 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

.6 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

.7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

.8 Provide spacers for glass lites where length plus width is greater than 1270 mm (50").

.1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

.2 Provide 3.2 mm (1/8") minimum bite of spacers on glass and use thickness equal to sealant width.

.9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.

.10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

.11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.

.12 Glaze hollow metal doors and frames specified under work of Section 08 11 13 using tape glazing installation.

3.4 Tape Glazing

.1 Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

.2 Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

.3 Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

.4 Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

.5 Do not remove release paper from tape until right before each glazing unit is installed.

.6 Centre glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings.

3.5 Gasket Glazing (Dry)

.1 Allow gaskets to relax and cut compression gaskets to lengths recommended by gasket manufacturer to fit openings to suit frame dimensions.

.2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

.3 Installation with drive-in wedge gaskets: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

.4 Installation with Pressure-Glazing Stops: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

.5 Install gaskets so they protrude past face of glazing stops.

3.6 Sealant Glazing (Wet)

.1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

.2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

.3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 Installation - Mirrors

.1 *Provide* frameless mirrors only. Grind and polish exposed mirror edges.

.2 Mount mirrors in true planes, free of distortions. Surfaces of butted mirrors shall be flush to ≤ 1 mm (0.04"). Mirror installation shall be flat to within 1.5 mm in 1220 mm (1/16" in 4 ft).

.3 Locate joints in mirrors at maximum available mirror sizes to *Consultant*'s direction, unless otherwise indicated. *Provide* butt joints with flat ground and polished edges to provide inconspicuous joint complete with black tape behind joint to hide wall substrate.

.4 Mirror clip support installation:

.1 Secure mirrors in place over pressure sensitive foamed plastic tape with metal clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.

.5 Mastic adhesive and top and bottom support clip installation:

.1 Secure mirrors in place over mastic adhesive with metal clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.

.2 Make sure mirror and substrate are free of dust, clean, and dry. On nonporous substrates, such as glass, tile, or metal, sealing is not necessary. On porous substrates, such as drywall or wood, use Mirro-Mastic Bond (or a primer or sealer, not paint) on the substrates and allow it to dry. Painted surfaces should be sanded through to the original surface and the substrate cleaned and sealed where the mastic is to be applied.

.3 Support mirror at the bottom using concealed bottom angles.

.4 Apply mirror adhesive to the mirror or substrate in a minimum of 1 ping-pong ball size mound for every 0.0929 m^2 (1 ft^2) of mirror. Do not apply mastic too close to the edge to prevent "squeeze out". Place the mounds so space will be left between them when the mirror is installed. Mastic adhesive shall be at room temperature (22°C (72°F)).

.5 Press mirror firmly in place making good contact between the mirror, mastic, and substrate. Mastic should spread to a pat approximately 114 mm (4-1/2”) in diameter. The mastic needs air circulation to cure properly. Curing time will depend on temperature, humidity, type of substrate, and amount of air that can reach the mastic.

3.8 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Performing random testing on:

.1 Surface compression tests on heat strengthened and tempered glass.

.2 Manufacturer’s field review to be in accordance with Section 01 45 00.

3.9 Protection

.1 *Provide* safety markings to installed glass by attaching streamers or tape to face of sash. Do not apply tape directly to the glass. Do not mark the glass with paint or any other substance that is hard to remove or could leave permanent stains.

.2 Take all precautions necessary to protect stored glass and installed glass from lime mortar, water run-off from concrete or copper, weld spatter, acids, roofing tar, solvents, abrasive cleaners, careless handling of construction machinery and equipment, and any other activities that could permanently damage the glass.

.3 Install protective cover to glass where there is a high risk of damage. Use plywood, heavy kraft paper, or non-staining transparent plastic sheet. Do not let protective materials contact surface of glass.

.4 Do not rely on use of adhesive plastic films to protect installed glass. When plastic sheeting is used, it must be transparent, suspended away from the surface of the glass, and be provided with adequate ventilation holes to prevent heat build-up.

3.10 Adjusting and Cleaning

.1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.

.2 Final cleaning of glass in accordance with Section 01 78 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Translucent film; applied to interior glazing (FLM-1).

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Samples:

.1 Submit 3 - 200 mm x 200 mm (8" x 8") samples of each specified film type, pattern and colour.

1.3 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit maintenance and cleaning instructions for incorporation into operating and maintenance manuals.

.2 Instruct *Owner's* representative on proper care and maintenance for work of this section.

1.4 Quality Assurance

.1 Qualifications:

.1 Subcontractor: Shall have 5 years' experience, minimum, in application of *Products* specified.

1.5 Delivery, Storage, and Handling

.1 Package materials and identify on attached labels the manufacturer, contents and material specification number.

1.6 Field Conditions

.1 Conform to manufacturer's written documented temperatures, relative humidity, and substrate moisture content and temperature for application of materials of this section.

PART 2 - PRODUCTS

2.1 Materials

.1 Applied films; translucent (FLM-1):

.1 Acceptable *Products*: Refer to Material Legend.

PART 3 - EXECUTION

3.1 Examination

.1 Examine glass surfaces to receive film and verify that they are free from defects and imperfections which will affect the final appearance of installed film. Correct such deficiencies before starting film application.

3.2 Preparation

.1 Prepare surfaces for film application in accordance with film manufacturer’s written requirements.

.2 Window and window framing will be cleaned thoroughly with a neutral cleaning solution. Surface of glass shall be bladed with industrial razor to ensure the removal of any foreign contaminants in accordance with film manufacturer’s instructions.

.3 Towelling or other absorbent material shall be placed on the window sill or sash to absorb moisture accumulation generated by the film application.

3.3 Installation

.1 Applied film; interior application:

.1 Apply film to indicated surface of glazing units in accordance with film manufacturer’s written requirements, applied plumb, true and level over clean glazing, without air bubbles, wrinkles, blisters, and other defects.

.2 After installation, applied film shall be flat with no obvious concentrations of moisture, free of creases, free of tears, with no moisture dimples when viewed under normal conditions.

.3 Film edges shall be cut neatly and square at a uniform distance of 1.5 mm (1/16") to 0.79 mm (1/32") from frame.

3.4 Adjusting and Cleaning

.1 Clean film and glass surfaces so they are free of foreign matter using cleaners recommended by film manufacturer.

3.5 Protection

.1 Comply with manufacturer's written requirements respecting protection.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Metal support systems for interior gypsum and cement board partitions, interior ceilings, and interior assemblies as indicated.

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the *Work* of this section, including additional data as may be required to demonstrate compliance with the *Contract Documents*.

.3 Test and evaluation reports:

.1 Submit certified test results for each required fire resistance rated assembly for work of this section.

1.3 Quality Assurance

.1 Qualifications:

.1 Installers / applicators / erectors:

.1 *Subcontractor*: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements - Fire Resistance Rated Assemblies

.1 Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

2.2 Materials - General

.1 For sheet metal *Products*: Sheet metal thickness indicated herein pertains to the minimum base steel thickness exclusive of coating.

.2 Protective coatings for metal supports and framing:

.1 Minimum corrosion protection: Z120 (G40) ASTM A653/A653M-13.

.2 Heavy duty corrosion protection where schedule or indicated: Z275 (G90) ASTM A653/A653M-13.

.3 Sheet metal screws shall have a minimum coating thickness of 0.008 mm (0.0003") of zinc. Other coatings providing equal or better corrosion protection may be used, subject to acceptance of *Consultant*.

.4 Screws:

.1 Steel screws shall be equal to or exceed minimum diameter indicated on shop drawings.

.2 Penetration beyond joined materials shall be not less than 3 exposed threads.

.3 Thread types and drilling capability shall conform to manufacturer's recommendations.

2.3 Partition Support Materials

.1 Interior non-loadbearing channel stud framing: to ASTM C645-18; roll formed from 0.455 mm (0.0179") minimum thickness unless otherwise indicated or as recommended by gypsum board manufacturer, galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.

.1 Steel studs at door jambs and where indicated: 1.720 mm (0.0677") minimum thickness.

.2 Steel studs; at backer plate locations: 0.836 mm (0.0329") minimum thickness.

.3 Steel studs at cement board locations: 0.836 mm (0.0329") minimum thickness.

.4 Steel studs at impact resistant gypsum board locations: 0.836 mm (0.0329") minimum thickness.

.2 Interior non-loadbearing channel stud framing: to ASTM C645-18; roll formed from 0.836 mm (0.0329") minimum thickness unless otherwise indicated, galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.

.3 Interior floor and ceiling tracks (runners): to ASTM C645-18; in widths to suit stud sizes.

.1 Metal thickness: to match studs.

.2 For openings wider than 914 mm (36"), provide 0.836 mm (0.0329") minimum thickness for header.

.4 Interior floor and ceiling track (runner) fasteners:

.1 To concrete and masonry: Use stub nails or power-driven fasteners.

.1 Power actuated fastening systems are not permitted.

.2 To suspended acoustic ceiling tile grid: Manufactured to fit applicable ceiling grid profile; CGC 'Partition Clip'.

.5 Bracing channels: Minimum 19 mm x 10 mm x 1.087 mm (3/4" x 3/8" x 0.0428") cold rolled galvanized steel.

2.4 Ceiling Support Materials and Systems

.1 General: Size ceiling support components to comply with ASTM C754-20 unless otherwise indicated.

.2 Main runners: Steel channels, hot or cold rolled; Z180 (G60) galvanized.

.3 Hanger wire: in accordance with ASTM A641/A641M-09A(2014), soft, Class 1 galvanized, minimum 4.064 mm (0.160", 8 AWG).

.4 Hanger rods and flats: Mild steel with zinc coating, galvanized for exterior applications.

.1 General: Size devices for 5 times load imposed by completed system as determined in accordance with ASTM E488/E488M-22.

.2 Screws, clips, bolts, concrete inserts or other devices for ceiling hangers whose suitability for use intended has been proven through standard construction practices or by certified test data.

.3 Hangers: Comply with ASTM C754-20 for maximum ceiling area and loads to be supported.

.4 Interior concrete ceiling anchors:

.1 Acceptable *Products*:

.1 ITW Ramset/Red Head 'Dynabolt Sleeve Anchor TW-1614' or 'Redi-Drive Tie Drive' or 'Redi-Drive' with angle clip.

.2 ITW Ramset/Red Head 'Trubolt' or 'Dynabolt' anchors complete with galvanized angle clip.

.3 Hilti 'Kwik-Bolt 3' and 'HHDCA 1/4 Ceiling Hangers'.

.5 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.

.5 Tie wire: 1.19 mm (0.047", 18 AWG) minimum zinc coated, soft-annealed wire, to ASTM A641/A641M-09A(2014).

.6 Furring anchorages: 1.62 mm (0.0637", 16 AWG) galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C754-20.

.7 Runner (carry) channels: 1.367 mm (0.0538") thick cold rolled steel, primer painted or zinc coated for interior locations, Z275 galvanized for exterior locations, to ASTM C754-20, with minimum 228 MPa yield strength:

.1 38 mm x 12.7 mm (1-1/2" x 1/2") where supported at centres of 914 mm (36") maximum.

.2 38 mm x 19 mm (1-1/2" x 3/4") where supported at centres of 1220 mm (48") maximum.

2.5 Furring

.1 Furring channels: 0.455 mm (0.0179") minimum typical thickness, cold rolled steel, wiped coated, nominal size of 22 mm (7/8") depth x 35 mm (1-3/8") face, hat type with knurled face.

.2 Z-furring members: Galvanized steel z-shaped furring members; ASTM A653/A653M-13, G60, 0.836 mm (0.0329") minimum thickness of base metal, of depth indicated, designed for mechanical attachment of insulation boards or blankets.

.3 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated, load rating and spacing to support materials carried by assembly with factor of safety of 3x per fastener manufacturer data sheets.

2.6 Accessories

.1 Backer plates:

.1 Metal backer plates: Steel, galvanized; minimum 150 mm (6") wide x 0.836 mm (0.0329”) minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.

.2 Plywood backer plates: Softwood plywood; 19 mm (3/4") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.

.3 Dimensional wood blocking in accordance with Section 06 10 53 Rough Carpentry.

.4 Elimination of backer plates or direct attachment of accessories or equipment to studs will not be permitted.

PART 3 - EXECUTION

3.1 Installation General

.1 Comply with ASTM C754-20 and manufacturer's requirements, except as modified herein. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.

.2 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:

.1 Do not exceed 3 mm (1/8") in 3 m (10’) variation from plumb, level, and plane.

.2 Do not exceed 10 mm (3/8”) from drawings locations.

.3 Do not exceed 1.5 mm (1/16”) variation between planes of abutting edges or ends.

.4 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.

.5 In double stud walls, do not bridge across studs on opposite sides of wall with gypsum board or metal cross bracing.

.3 Give complete cooperation and direction to trades erecting framing and furring over which this work is applied. Coordinate finished joint location with framing.

.4 Coordinate installation and cooperate with mechanical and electrical work to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with the partitions, ceiling and soffit systems.

.1 Where the presence of suspended ductwork or other mechanical or electrical services or devices above ceiling framing conflicts with ceiling framing suspension points from structure above, provide bridging framing below conflicting work as required to support ceiling framing on specified intervals.

.2 Do not suspend ceiling framing from mechanical or electrical suspension systems unless agreement is obtained in writing from engineer for *Subcontractor* installing such framing that additional imposed loads are acceptable; obtain *Consultant's* acceptance before proceeding.

.5 Provide clearances between work of this section and structural elements to prevent transference of structural loads.

.6 Do not bridge building expansion joints with steel framing or furring members. Independently frame both sides of joints with framing of furring members or as indicated.

.7 Size framing systems according to manufacturer's engineered load tables, to meet allowable deflection without permanent deformation.

.1 Maximum allowable deflection: L/240.

3.2 Blocking

.1 Attach to framing adequate backer plates to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this section.

3.3 Furring - General

.1 Furring indicated in *Contract Documents* is schematic. Do not regard as exact or complete. *Provide* all necessary framing and furring to support gypsum board in accordance with manufacturers' specifications.

.2 Shim furring as required to achieve required installation tolerances.

.3 Leave finished work rigid, secure, square, level, plumb, curved to detailed radius and erected to maintain finish gypsum board line dimensions and contours. Make allowance for thermal movement.

.4 Thermally separate metal studs from exterior concrete or masonry.

3.4 Suspended and Furred Ceilings

.1 Arrange hangers for suspended gypsum board ceilings to provide support independent of walls, columns, pipes, ducts; erect plumb, and securely anchored to structural frame, or embed in concrete slabs.

.2 Keep lateral braces at hangers back 450 mm (18") minimum unless otherwise noted.

.3 Space hangers at 914 mm (36") on centre maximum along runner channels, and not more than 150 mm (6") from ends.

.4 Space runner channels at 1220 mm (48") on centre, maximum, and not more than 150 mm (6") from boundary walls, interruptions of continuity, and changes in direction. Run channels transversely to structural framing members.

.5 Where splices are necessary, lap members at least 200 mm (8") and wire each end with 2 loops. Avoid clustering or lining up of splices.

.6 Attach to rod hangers by bending hanger sharply under bottom flange of runner, and securely wiring in place with saddle tie.

.7 Erect cross furring channels transversely across runner channels at 400 mm (16") on centre maximum, 305 mm (12") on centre at fire rated assemblies, at not more than 150 mm (6") from boundary wall openings, interruptions in ceiling continuity, and changes in direction.

.8 Secure furring channels to each support with purpose-made slips or wire tie. Splice joints by lapping channels and tying together.

.9 Install proprietary ceiling systems in accordance with manufacturer's written directions.

.10 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8” in 10 ft).

3.5 Wall Furring

.1 Install steel furring for braced walls, free standing walls, walls that are furred out as indicated.

.2 Frame openings and around built-in equipment, cabinets, access panels, on 4 sides, with channels. Extend furring into reveals. Check clearances with equipment suppliers.

.3 *Provide* bulkheads and boxed-in duct shafts, for beams, columns, pipes and around exposed services where indicated. Install 19 mm (3/4") channels at corners and at 305 mm (12") on centre.

3.6 Metal Stud Partition Framing

.1 Provide partition tracks (runners) at floor and underside of structural assembly and as follows:

.1 Align accurately and lay out according to partition layout.

.2 Secure runners to concrete, access flooring and to concrete slabs, as applicable, with screwed or shot fasteners located 50 mm (2") from each end and spaced at maximum 610 mm (24") on centre.

.3 At partition corners, extend one runner to end of corner and butt other runner to it, allowing necessary clearance for gypsum board thickness. Runners should not be mitred.

.2 Unless otherwise indicated, place interior studs vertically at centres as follows:

.1 *Provide* studs at 400 mm (16") on centre, and as specially spaced in accordance with details indicated.

.2 *Provide* studs not more than 50 mm (2") from abutting walls, openings and each side of corners.

.3 *Provide* freedom for 19 mm (3/4") deflection under beams, structural slabs and the like to avoid transmission of structural loads to studs, or install 50 mm (2") leg ceiling tracks.

.3 Install studs in tracks at floor and ceiling.

.4 Where horizontal runs of service lines are scheduled to be installed, arrange with applicable trades and install studs simultaneously with services.

.5 At openings in stud walls, erect track at head and sills to accommodate intermediate studs. At each end of track, cut out flanges, turn up web, and fasten to studs. Install intermediate studs above and below openings in same manner and spacing as wall studs. Install double studs at each jamb, and double tracks at head of door openings.

.6 At partitions requiring fire rating, erect in accordance with requirements of listing.

.7 Size studs, connections, and runners to carry loads according to stud manufacturer’s load tables, at 24 kg/m^2 (5 lb/ft^2) live load to meet maximum allowable deflection limits. Where depth of stud is indicated, size metal thickness to meet allowable deflection limits.

.8 *Provide* three studs at corner and intermediate intersections of partitions.

.9 Coordinate work with others installing horizontal runs of service lines so that work is done simultaneously. Where standard holes are too small for installed services, notch studs, and splice notched flanges with splice pieces 305 mm (12") longer than notches, each fastened with 2 screws.

.10 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.11 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other sections.

.12 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structure above.

.13 Chase walls:

.1 *Provide* chase walls consisting of two parallel steel stud partitions.

.2 *Provide* cross bracing consisting of metal furring, located at quarter points on each pair of studs. Attach cross bracing to studs with metal screws.

.14 Lateral support bracing channels:

.1 Stiffen partitions over 3 m (10’) in vertical span, at mid-height to maximum vertical spacing of 2440 mm (8’) on centre, with at least one 19 mm (3/4") horizontal bracing channel, extending full length of partition, overlapping at least two stud spaces at ends of bracing channels.

.2 Stiffen partitions at not more than 150 mm (6") from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.

.15 Install steel stud reinforcement 1.720 mm (0.0677”) at door frames and brace above ceiling. Secure to top and bottom structure with angle brackets and anchors.

.16 Partitions that are tied to the ceiling or hung from the structure, shall be laterally braced to the building structure.

3.7 Control Joints

.1 Control joints: in accordance with Section 09 29 00.

3.8 Concrete Anchors

.1 Provide anchors and anchorage points in reinforced concrete floor slab underside in accordance with gypsum board manufacturer’s suspension requirements. Drill holes with carbide-tipped drill bits conforming to ANSI B212.15-1994 (R2000).

.2 *Provide* anchors; minimum installation depth, and method of expansion as recommended by the anchor manufacturer.

3.9 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Gypsum board; paper-faced.

.2 Gypsum board; interior mould and moisture resistant; glass scrim faced.

.3 Gypsum board; fire-rated, paper-faced.

.4 Gypsum board; impact resistant.

.5 Cement board; tile backer board.

.6 Gypsum board accessories and miscellaneous related materials.

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Fire-rated assembly listings and STC assembly ratings:

.1 Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.

.2 Submit STC assembly ratings for each required STC rated assembly for work of this section.

1.3 Quality Assurance

.1 Qualifications:

.1 *Subcontractor*: Shall have 10 years' experience, minimum, in successful installation of work of type and quality indicated and specified.

.1 *Subcontractor*: Shall be a member in good standing of the Association of Wall and Ceiling Contractors of Alberta (AWCC), for at least 5 years.

.2 *Subcontractor*: Shall be a member in good standing of the British Columbia Wall and Ceiling Association (BCWCA), for at least 5 years.

1.4 Field Conditions

.1 Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum boards.

.2 Install paper-faced gypsum panels after installation areas are enclosed and conditioned.

.3 Panels that are wet, moisture damaged, or mould damaged shall not be installed.

.1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

.2 Indications that panels are mould damaged include, but are not limited to, fuzzy or splotchy surface contamination and discolouration.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Single source responsibility: Obtain gypsum and cement board products from a single manufacturer.

.2 Fire resistance rating:

.1 Construct fire resistance rated assemblies in accordance with listing and CAN/ULC S101-14.

.3 Paper-faced gypsum board: in accordance with ASTM C1396/C1396M-17.

.4 Glass scrim gypsum board: in accordance with ASTM C1658/C1658M-13.

.5 Fire rated in accordance with listed assemblies where indicated: Type X or Type C.

2.2 Gypsum Board Panels

.1 Gypsum board; paper faced:

.1 Minimum thickness: 16 mm (5/8").

.2 Acceptable *Products*:

.1 CertainTeed ‘Regular Gypsum Board’.

.2 CGC ‘Sheetrock Brand Gypsum Panel’.

.3 Georgia-Pacific ‘ToughRock Gypsum Board’.

.4 National Gypsum ‘Gold Bond Gypsum Board’.

.2 Gypsum board; interior mould and moisture resistant, glass scrim:

.1 Resistant to mould growth with highest level of performance (score of 10) when tested to ASTM D3273-16.

.2 Acceptable *Products*:

.1 CGC ‘Sheetrock Brand Glass-Mat Panels Mold Tough Regular/Firecode X’.

.2 Georgia-Pacific ‘DensArmor Plus Fireguard High-Performance Interior Panel’.

.3 Substitutions: in accordance with Section 01 25 00.

.3 Gypsum board; fire-rated, paper faced:

.1 Acceptable *Products*:

.1 CertainTeed ‘Type X and Type C’.

.2 CGC ‘SHEETROCK Brand Firecode X and Firecode C’.

.3 Georgia-Pacific ‘ToughRock Fireguard X Gypsum Board and ToughRock Fireguard C Gypsum Board’.

.4 National Gypsum ‘Gold Bond Brand Fire-Shield Gypsum Board and Gold Bond Fire Shield C Gypsum Board’.

.5 PABCO Gypsum ‘QuietRock ES’.

2.3 Cement Board Panels

.1 Cement board; interior and exterior grade, tile backer board and sheathing applications:

.1 Composition: Portland cement, sand, and may contain expanded polystyrene beads, with a fully embedded alkali resistant glass fibre mesh facing. Free of gypsum, organic fibres or cellulose.

.2 Acceptable *Products*:

.1 CGC ‘Durock'.

.2 National Gypsum ‘PermaBase Plus Cement Board’.

.3 Substitutions: in accordance with Section 01 25 00.

2.4 Attachment Materials

.1 Screws; for gypsum board: bugle head, fine thread, self-tapping, Type W or S or S-12 point to suit framing type and metal gauge, with corrosion resistant finish in accordance with ASTM C1002-07/ASTM C954-11.

.1 Screw sizing:

.1 #6 x 25 mm (1") for single thickness board fastening.

.2 #6 x 32 mm (1-1/4") for single thickness 15.9 mm (5/8") board fastening.

.3 #7 x 41 mm (1 5/8") for double thickness board fastening.

.2 Screws; for cement board: Wafer head, Type S-12 point or 'Hi-Lo', self-tapping, with corrosion resistant polymer finish.

.3 Tie wire: 1.6 mm (0.063") diameter galvanized soft annealed steel wire.

.4 Laminating adhesive; for gypsum panels only: in accordance with gypsum board manufacturer's written installation requirements, to suit application.

.1 Use adhesives that have a VOC content of 50 g/L (1.8 oz/gal) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 Accessories

.1 Accessories: in accordance with ASTM C1047-19 unless otherwise indicated, maximum length pieces per location. Flanges shall be free from dirt, grease, or other material that adversely affects the bond of joint treatment or decoration.

.2 Trims:

.1 Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. Refer to drawings for trim types.

.1 Shapes:

.1 Inside and outside corner bead.

.1 Mechanically fastened corner beads at impact resistant gypsum walls.

.2 “L” or “LC” beads.

.3 Reveal trims.

.4 Ceiling junction trims, curved where required.

.5 Wall junction trims, curved where required.

.6 Control joints, certified by manufacturer for use at fire resistance rated assemblies as required.

.3 Aluminum trims: extruded accessories of profiles and dimensions as indicated.

.1 Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.

.2 Shapes:

.1 Z reveal.

.2 Reveals and moldings at round columns.

.3 Acceptable manufacturers:

.1 Fry Reglet.

.2 Gordon Interior Specialties.

2.6 Related Support Assemblies and Backer Plates

.1 Dimensional wood blocking at interior assemblies: in accordance with Section 06 10 53.

.2 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.7 Joint Treatment Materials

.1 General: Comply with ASTM C475/C475M-17(2022).

.2 Joint tape: in accordance with manufacturer's written requirements.

.3 Joint compound for interior gypsum board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

.1 Prefilling: Use setting-type compound as recommended by panel board manufacturer.

.2 Embedding and first coat: Use setting-type or taping compound as recommended by panel board and trim accessory manufacturers.

.3 Fill and finish coats: Use sanding type setting-type or taping compound as recommended by panel board manufacturer.

.4 Joint compound for exterior applications: in accordance with manufacturer's written requirements.

.5 Joint compound for tile backing panels: in accordance with manufacturer's written requirements.

2.8 Acoustic Wall Assembly Materials

.1 Acoustic sealant; concealed locations: to meet material requirements as listed in Part 9 of ASTM C919-22, including ASTM C834-10 or ASTM C920-14:

.1 Acceptable *Products*:

.1 Hilti Canada Corp 'CS-S SA Light'.

.2 Owens Corning 'QuietZone Acoustic Sealant'.

.3 Pecora 'BA-98'.

.4 Pecora 'AC-20'.

.5 Tremco 'Tremflex 834'.

.6 Substitutions: in accordance with Section 01 25 00.

.2 Acoustic sealant; exposed locations, acrylic:

.1 Acrylic/latex acoustic sealant, Type S, Grade NS, Class 12.5 to ASTM C920-14, maximum VOC content 60 g/L, non-hardening or ASTM C834-10, ASTM C834-10, ASTM C834-10.

.2 For exposed sealants use paintable sealant products, do use non-skinning type products where they are exposed to view or where sealant products may deteriorate (stain or bleed into) into painted surfaces.

.3 Acceptable *Products*:

.1 Hilti Canada Corp 'CS-S SA Light''.

.2 Master Builders Solutions Canada 'MasterSeal NP 520'.

.3 Owens Corning 'QuietZone Acoustic Sealant'.

.4 Pecora 'AC20'.

.5 Tremco 'Tremflex 834'.

.3 Smoke and acoustic sealant; concealed and exposed locations, non-fire-rated acoustic assemblies:

.1 Acrylic smoke and acoustic sealant, in accordance with ASTM C834-10 maximum VOC content 60 g/L, paintable, Flame Spread Value of maximum 25 to CAN/ULC S102.

.2 Sealant shall not deteriorate (stain or bleed into) painted surfaces.

.3 Acceptable *Products*:

.1 Hilti Canada Corp 'CS-S SA Light'.

.2 Tremco 'Tremstop Smoke & Sound Sealant'.

.3 Substitutions: in accordance with Section 01 25 00.

.4 Acoustic sealant for plenum locations: Smoke-seal sealant with flame-spread not more than 25 and smoke developed classification not more than 50 to CAN/ULC-S102-10, in accordance with Section 07 84 00.

.5 Acoustic compound: premixed perlite plaster.

.6 Acoustic (sound attenuation) insulation (INS-3):

.1 Mineral-fibre sound attenuation batts: in accordance with CAN/ULC S702-14, Type 1, fire resistant and non-combustible to CAN/ULC-S114-05, high density for sag-free, tight fitting installation.

.1 Density: minimum 40 kg/m^3 (2.5 lbs/ft^3).

.2 Acceptable *Products*:

.1 Johns Manville ‘MinWool Sound Attenuation Fire Batts’.

.2 Owens-Corning ‘Thermafiber SAFB’.

.3 Rockwool 'AFB'.

PART 3 - EXECUTION

3.1 Installation

.1 General:

.1 Comply with ASTM C840-18b, GA 216-21, GA 600-21, and manufacturer's written requirements, except as otherwise indicated.

.2 Do not bridge building expansion joints with support system.

.3 Frame both sides of joints with furring and other supports as indicated.

.4 Install work of this section in accordance with the 2012 Wall and Ceiling Specifications Standard Manual.

.2 Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.6 mm (1/16") open space between boards. Do not force into place.

.3 Cover both faces of stud partition framing with gypsum board in concealed spaces (above ceiling, and the like) unless otherwise indicated, except in chase walls which are properly braced internally.

.4 Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cut-outs.

.5 Apply components of fire-rated assemblies in conformance with indicated designs.

.6 Do not apply gypsum board in close proximity to hot pipes or heating ducts.

.7 Install materials with the minimum number of joints. Tightly butt joints, without force, and neatly align them.

.8 Frame openings on every side. Provide clearances with services.

.9 Work shall include bulkheads over doors, frames, screens, and changes in ceiling levels, pipe space and as indicated.

.10 Provide clearances between work of this section and structural elements to prevent transference of structural loads in accordance with Section 09 22 00.

.11 Tolerances:

.1 Do not exceed 3 mm (1/8") in 3 m (10’) variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.

.2 Do not exceed 10 mm (3/8”) from indicated location.

.3 Do not exceed 1.5 mm (1/16”) variation between planes of abutting edges or ends.

.4 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

3.2 Accessories

.1 At external corners install corner trim secured to framing at 230 mm (9-1/16") on centre on both flanges with screw fasteners or clinch tool.

.2 Secure casing trim at board edges where exposed to view, where board butts against other materials with no trim to conceal junction, at perimeter of ceiling surfaces at tops of partitions where they stop against continuous ceiling surfaces, and where indicated.

.3 Erect accessories straight, plumb or level, rigid and at proper plane.

.4 Use full length pieces.

.5 Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners, free from rough edges. Secure in accordance with manufacturer's specifications unless otherwise required.

.6 Installation tolerances:

.1 Alignment with board panels shall not exceed tolerances specified above.

.2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020”).

3.3 Board Application - General

.1 Before installation of board commences, ensure that internal services have been installed, tested, and approved; conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports installed by others are in place.

.2 Extend board into door, window, and other openings, reveals, behind fitments, and other applied items and on metal stud partitions to structure above unless indicated otherwise.

.3 Apply board with long dimension perpendicular to supports, unless otherwise indicated.

.4 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.

.5 Install board to minimize joints, and align end joints to be the least objectionable (where they are unavoidable), according to the indicated lighting design. Locate joints in ceilings where least prominently discerned, and never line them up with opening edges.

.6 Form smooth joints at ends and at field cut edges of board panels.

.7 Fasten board to metal support members by metal gypsum board screws, 9.5 mm (0.374") minimum to, and 12.7 mm (1/2") maximum from, centre of joints.

.1 Space screws:

.1 At fire rated board as per fire-rated assembly.

.2 At typical board walls at 400 mm (16") on centre at edges and field unless otherwise required.

.3 At typical board ceilings at 305 mm (12") on centre at edges and field unless otherwise required.

.8 Offset gypsum board joints 150 mm (6") minimum from corners of openings.

.9 Locate gypsum panel product joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

.10 Install expanded security mesh in accordance with manufacturer's written installation requirements.

3.4 Interior Mould and Moisture Resistant Gypsum Board Application

.1 Apply water resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

3.5 Impact Resistant Board Application

.1 Install impact resistance gypsum board in accordance with gypsum board manufacturer's written requirements.

.2 Where both impact resistant gypsum panels and plain gypsum board are used together on the same surface plane adjacent to one another, a smooth transition between the two types of boards is required. Finish the work in a manner such that the transition provides an inconspicuous joint when viewed by a person at normal viewing angles while standing in front of the boards from a distance of not less than 1000 mm (39").

.3 Finish level of impact resistance gypsum board for presentation dry erase wallcovering surfaces: in accordance with Section 10 11 00.

3.6 Interior Cement Board

.1 Install in accordance with manufacturer's written requirements.

.2 Section 09 31 00 to install tile setting material over tape installed by this section. Install mesh tape centred over tile backer board joints. Tape joints and angles.

3.7 Acoustic Wall Assemblies

.1 Acoustical sealant and plaster:

.1 Apply acoustical sealant to seal gaps in accordance with ASTM C919-22 and in accordance with the STC rated assembly.

.2 Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919-22and with manufacturer's written requirements for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

.3 Clean substrate, remove debris and deleterious substances.

.4 Apply sealant to close voids; no leaks around track and gypsum board.

.2 Sound attenuation insulation:

.1 Install sound attenuation insulation to fill cavity unless otherwise indicated.

.2 Trim insulation to provide close-fit contact to framing assemblies and fill the partition cavity or acoustic insulation assemblies to thicknesses specified or indicated.

.3 Maintain air space between backs of sound attenuation insulation and back of opposite partition face layer, as applicable.

.4 Cut insulation to provide close-fit contact around electrical boxes, pipes, and other obstructions and penetrations through and within acoustic assemblies.

.5 Extend acoustic partition assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.

.6 Staple sound attenuation insulation where required by manufacturer's installation requirements.

.7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.

.8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm (6").

.9 Secure insulation in such a manner that it will not sag or settle away from required locations.

.3 Sound flanking paths:

.1 Where sound rated partition walls intersect non rated gypsum board partition walls, extend sound rated construction to completely close sound flanking paths through non rated construction.

.2 Seal joints between face layers at vertical interior angles of intersecting partitions.

3.8 Finishing

.1 Provide levels of gypsum board finish for locations as follows, in accordance with GA-214.

.1 Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.

.2 Level 2: Gypsum board substrate at applied hard surfaces, except remove tool marks and ridges.

.3 Level 3: Skimming of existing drywall at new commercial grade vinyl wallcovering.

.4 Level 4: Exposed gypsum board surfaces, except where another finish level is indicated.

.2 Interior gypsum board:

.1 Prefill:

.1 Use setting-type joint compound. Mix joint compound according to manufacturer's written requirements.

.2 Fill joints between boards flush to top of eased or beveled edge.

.3 Fill joints of gypsum board above suspended ceilings in fire rated partitions.

.4 Wipe off excess compound and allow compound to harden.

.5 Prefill joint gaps not greater than 3.2 mm (1/8") with either ready-mix or setting type joint compound; prefill joint gaps greater than 3.2 mm (1/8") with setting-type joint compound.

.2 Taping (Level 1):

.1 Butter taping compound into inside corners and joints.

.2 Center tape over joints and press down into fresh compound.

.3 Remove excess compound.

.4 Tape joints of gypsum board above suspended ceilings.

.3 First coat (Level 2):

.1 Use taping or all-purpose drying-type compound.

.2 Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's written requirements.

.3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.

.4 Cover fastener heads and accessories with 1 coat of joint compound.

.4 Second coat (Level 3): After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 50 mm (2") beyond edge of first coat.

.1 Cover fastener heads and accessories with total of 2 separate coats of joint compound.

.5 Third coat (Level 4):

.1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 50 mm (2") beyond edge of second coat.

.2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.

.3 Finished joints will be accepted with a camber not greater than 1 mm (1/32") and shall be seamless, plumb, true and flush and with square, neat corners.

.4 Cover fastener heads and accessories with total of 3 separate coats of joint compound.

.5 Where new partitions align with existing gypsum board, apply required amount of skim coats to make transition inconspicuous from a distance of 914 mm (36”).

.6 Completed installation at interface between new and existing construction shall provide an inconspicuous joint.

.3 Interior mold and moisture resistant gypsum board: Treat fastener heads and joints with setting-type joint compound.

.1 For joints to be covered with tile, apply tape and joint compound bedding coat and skim coat only; do not apply finish coats.

.2 Do not crown joints or leave excess compound on panels.

.3 Remove tool marks and ridges.

.4 For fastener heads to be covered with tile, apply one coat of joint compound.

.4 Cement board: Prepare, tape, and finish joints in accordance with manufacturer's written requirements.

.5 Joint compound:

.1 Apply finish coat of compound feathering 75 to 100 mm (3” to 4”) beyond tape edges.

.2 Feather coats onto adjoining surfaces so that camber is maximum 0.79 mm (1/32”).

.6 Trim:

.1 Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.

.2 Install metal corner beads at external corners.

.3 Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi exposed, and where gypsum base terminates against dissimilar material.

.4 Erect beads plumb or level, with minimum joints.

.7 Control joints:

.1 Provide control joints set in board facing. Support control joints with studs or furring channels on both sides of joint.

.2 Provide control joints in required locations; including interior gypsum board.

.1 Review control joint locations with *Consultant* prior to installation.

.3 Install control joints where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the building structure.

.4 Install control joints where a wall or partition runs in an uninterrupted straight plane exceeding 9100 mm (30 linear feet).

.5 Install control joints in interior ceilings:

.1 With perimeter relief:

.1 Linear dimensions between control joints shall not exceed 15000 mm (50 ft) and total area between control joints shall not exceed 230 m² (2500 ft²).

.2 Without perimeter relief:

.1 Linear dimensions between control joints shall not exceed 9100 mm (30 ft) and total area between control joints shall not exceed 84 m² (900 ft²).

.6 Install control joints where ceiling framing members change direction.

.7 Where a control joint occurs in an acoustical or fire-rated system, provide blocking behind the control joint by using a backing material such as 16 mm (5/8") Type X gypsum panel products, mineral fibre, or other tested equivalent. Construct through-wall control joints at fire-rated assemblies in accordance with assembly listing requirements.

.8 Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements, where accepted by *Consultant*.

.9 Install control joints straight and true.

.10 Ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.

.11 Locate board joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

.8 Dry-erase wallcovering locations: Substrate and finish level requirements for presentation dry erase wallcovering surfaces in accordance with Section 10 11 00.

3.9 Fire Separations

.1 Install fire-rated assemblies in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by authorities having jurisdiction.

.2 Vertical bulkheads in ceiling spaces over fire rated partitions, doors and the like shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated.

.3 Use fire rated gypsum wallboard as specified.

.4 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.

.5 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed.

3.10 Access Doors

.1 Install access doors to mechanical and electrical fixtures specified in respective sections of Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

.2 Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services and consultation with *Consultant*.

.3 Rigidly secure frames to furring or framing systems.

3.11 Adjusting and Cleaning

.1 Clean up and remove surplus materials and rubbish resulting from the work of this section upon completion.

.2 Clean off beads, casings, joint compound droppings and the like, leave the work of this section ready for painting trades.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Interior hard surface tiling (PCT-1).

.2 Thin-set mortar for tiling.

1.2 References

.1 Definitions:

.1 Large format tile: Tiles with dimension measured along any edge 380 mm (15”) and greater.

1.3 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

.2 Sequencing and scheduling:

.1 Coordinate installation of tile work with related work.

.2 Proceed with tile work only after curbs, vents, drains, piping, and other projections through substrate have been installed and when substrate construction and framing of openings have been completed.

1.4 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer’s *Product* data sheets for *Products* proposed for use in the work of this section.

.2 Submit manufacturer’s installation requirements for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Indicate location and sizes of control joints.

.4 Samples:

.1 Submit 3 -full size samples of each type of tile specified.

.5 Test and evaluation reports:

.1 Submit moisture, alkalinity, and mortar bond test results.

.6 Tiling system manufacturer’s system warranty and design criteria:

.1 Submit tiling system manufacturer’s warranty specimen and warranty design criteria prior to the commencement of work of this section.

1.5 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer’s operation and maintenance requirements for inclusion in the operation and maintenance manuals.

.3 Maintenance materials:

.1 Provide minimum 2% of each type and colour of tile required for the *Work* for maintenance use.

.2 Maintenance material to be of same production run as installed material.

1.6 Quality Assurance

.1 Qualifications:

.1 *Subcontractor*:

.1 Has adequate plant, equipment, and skilled workers to perform the work expeditiously.

.2 Has successfully completed installations similar to that specified during a period of at least the immediate past 5 years.

.3 Shall be a member company in good standing of the Terrazzo, Tile and Marble Association of Canada and have been a member for at least the past 5 years.

.2 Mock-ups:

.1 Grouted mock-up: 1220 mm x 1220 mm (48" x 48") sample panels of each tile type and colour, texture, size, and pattern of tile and grout.

.2 Non-grouted mock-up: 1220 mm x 1220 mm (48" x 48") area for each type and colour, texture, size, and pattern of tile.

.3 Mock-up shall consist of floor/wall/base corner intersection, with 300 mm (12") of finish product on each face and control joints.

1.7 Field Conditions

.1 Ambient conditions:

.1 Execute work of this section while ambient temperature and humidity within safe working temperatures in accordance with manufacturer's installation requirements for a period of 72 hours before, during and following installation. Avoid concentrated or irregular heating during curing period.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 ANSI - American Standard Specification for the Installation of Ceramic Tile.

.2 Terrazzo, Tile and Marble Association of Canada (“TTMAC”) Specification Guide 09 30 00 Tile Installation Manual TTMAC 2019-2021 Specification Guide 09 30 00, Tile Installation Manual.

.1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.

.2 Tiling systems shall exhibit none of the following once installed:

.1 Staining or discolouration of tile due to mortar or grout.

.2 Delaminating of tile.

.3 Cracked or chipped tiles.

.4 Cracked grout.

2.2 General

.1 Single source responsibility: In any given space, use mortar and grout from a single manufacturer.

.2 Tile products shall be from same production run, dye lot, calibre, and batch number. If shading variation is evident, notify *Consultant* prior to installation.

2.3 Tile Products

.1 Floor and wall porcelain tile (PCT-1): Refer to Material Legend.

2.4 Mortar Materials

.1 Unless otherwise specified, select from the following thin-set mortar:

.1 Mortar for large format tiles meeting definition under paragraph 1.2.1.1:

.1 Enriched, modified, fast-set Portland cement medium bed mortar high-hydration, low residual moisture behind the tile formula.

.2 ANSI A118.4 (ANSI A108/A118/A136.1-20) and ANSI A118.11 (ANSI A108/A118/A136.1-20).

.3 Substrate primer: in accordance with manufacturer’s installation requirements.

.4 White colour for translucent tile applications and light coloured stones.

.5 Acceptable *Products*:

.1 Ardex 'S 28 Microtec Rapid Hardening and Rapid Drying Semi-Pourable Natural Stone Floor Tile'.

.2 Custom Building Products: ‘MegaLite’.

.3 Flextile ‘58XT’.

.4 Mapei ‘Granirapid’.

.5 Laticrete ‘4-XLT Rapid’.

.6 Profix ‘Flex GT-30’.

.7 Profix ‘Optiflex’ Full-Contact Mortar.

.8 Promo Adhesives Inc. ‘Pro Quick SF’ with ‘Pro Quick Plus Additive’.

.9 TEC ‘Fast Set Ultimate Large Tile Mortar’.

.10 TEC ‘Fast Set 3N1 Performance Mortar’.

.2 Levelling underlayment:

.1 Cement-based, quick-setting, self-levelling, self-drying underlayment for installations from featheredge to minimum 32 mm (1") thick in single application.

.2 Primer: Type as recommended by levelling underlayment manufacturer to suit substrate.

.3 Acceptable *Products*:

.1 Ardex 'Liquid BackerBoard Self-Levelling Underlayment'.

.2 Ardex 'TL 1000'.

.3 Custom Building Products 'TechLevel 100'.

.4 Flextile '5900 Flex-Flo Plus Self-Levelling Underlayment'.

.5 Laticrete 'Supercap SC500'.

.6 Mapei 'Ultraplan 1 Plus'.

.7 Promo Adhesives Inc. 'Pro Plan'.

.8 TEC 'Contractor Grade Self Levelling'.

.9 TEC 'Levelset 200'.

2.5 Grout Materials

.1 Latex-Portland cement grout and Portland cement grout:

.1 Sanded (for joints between 3.2 mm (1/8") and 12.7 mm (1/2") and for floor tiling) and unsanded (for joints greater than 1.5 mm (1/16") less than 3.2 mm (1/8") and for wall, ceiling tiling:

.2 ANSI A118.6 (ANSI A108/A118/A136.1-20) or ANSI A118.7 (ANSI A108/A118/A136.1-20)

.3 Acceptable *Products*:

.1 Ardex 'FG-C Microtec (unsanded)', 'FL Rapid Set, Flexible Sanded'.

.2 Custom Building Products: 'Polyblend Non-Sanded Grout', Polyblend Sanded Grout'.

.3 Flextile '500 Polymer Modified Non-Sanded', '600 Polymer Modified Sanded Grout'.

.4 Laticrete 'Tri-Poly Fortified Sanded Grout (1500 Series), Laticrete 'Tri-Poly Fortified Unsanded Grout (1600 Series)' gauged with Laticrete '1776 Admix Plus'.

.5 Mapei 'Keracolor S' Sanded Grout, Mapei 'Keracolor U' Unsanded Grout'.

.6 Profix 'Poly 500 Sanded Grout', Profix 'Poly 600 Unsanded Grout'.

.7 Promo Adhesives Inc. 'Pro Grout Sanded', Promo Adhesives Inc. 'Pro Grout Un-Sanded'.

.8 TEC 'AccuColor Premium Sanded Grout', TEC 'AccuColour Premium Unsanded Grout'.

.2 Grout colours to later selection by *Consultant* from manufacturer's full range.

.3 Grout sealer: as recommended by grout manufacturer.

2.6 Sheet Waterproofing/Uncoupling Membrane Materials

.1 Review floor assembly design (live load deflection) with *Consultant* and uncoupling membrane manufacturer's representative. Confirm uncoupling membrane manufacturer's recommended product to *Consultant* in writing, on uncoupling membrane manufacturer's company letterhead prior to commencing the installation.

.2 Floors; waterproofing/uncoupling membrane:

.1 High density corrugated polyethylene matting with dovetail-shaped ribs with polypropylene-fibre support webbing laminated to the underside to provide a mechanical bond to the substrate mortar. Membrane meets or exceeds ANSI A118.10 (ANSI A108/A118/A136.1-20) and ANSI A118.12 (ANSI A108/A118/A136.1-20).

.2 Acceptable *Products*: as indicated on the drawings.

.3 Accessories:

.1 Mortar for setting tile and installing membranes and membrane waterproofing accessories: Compatible product as recommended by sheet uncoupling membrane manufacturer.

.2 Membrane waterproofing accessories:

.1 Use Schluter 'KERDI-BAND' to seal waterproofing membrane seams and joints where manufacturer preformed corners cannot be used.

.2 Use 'KERDI-FLEX' to seal expansion joints or flexible edge joints.

.3 Use 'KERDI-KERS-B' and 'KERDI-KERS for inside and outside corners.

.4 Use 'KERDI-SEAL-PS/-MV' for sealing pipe protrusions.

.5 Use 'KERDI'FIX' to seal pipe protrusions where 'KERDI-SEAL-PS/-MV' cannot be used.

2.7 Accessories and Related Materials

.1 Trim accessories: as indicated on the drawings.

.2 Joint sealants: mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

.1 Ensure compatibility of *Products* supplied under this section, and which bear contact with substrate.

.2 Before work of this section commences, examine the areas to be covered and report any flaw or adverse conditions in writing to the *Contractor* and the *Consultant*. Do not proceed with work until surfaces and conditions comply with the requirements indicated in the manufacturer's requirements and in ANSI A108.5 (ANSI A108/A118/A136.1-20) specification.

.3 Miscalibrated tiles, tiles with chipped corners, tiles with holes, will not be accepted for installation.

.4 Inspect tiles for colour variation. Tiles presenting noticeable variations shall be carefully selected, set aside and used in areas where they fit in the pattern homogeneously. Provide for appropriate lighting equipment in addition to existing lighting in the immediate area where the installation is being performed so that any shade differences which are normally very slight can be identified easily.

3.2 Preparation

.1 Completely remove contaminants and deleterious substances and debris which may prevent, reduce, and affect adhesion or performance or may act as bond breaker.

.2 Wire brush steel substrates to remove deleterious substances and rust, to promote full adhesion to steel.

.3 Roughen surfaces with previously painted glossy finishes by sandpaper or other abrasive medium, and completely remove finishes which are not compatible with products specified under this section.

.4 Prime gypsum, wood or porous concrete with primer, brush or roller applied at full strength in accordance with mortar manufacturer's recommendations.

.5 Floor surfaces:

.1 Prepare concrete to receive levelling underlayment in accordance with International Concrete Repair Institute (ICRI) designation CSP-3.

.2 Prepare concrete to receive waterproofing membrane in accordance with International Concrete Repair Institute (ICRI) designation CSP-2.

.3 Concrete shall be minimum of 90 days old.

.4 At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide trowel-applied levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper trowel-applied 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.

.6 Concrete shall be dry with maximum allowable moisture in accordance with product manufacturer’s written requirements for products to be installed directly over concrete.

.7 Alkalinity, moisture, and adhesion testing:

.1 Perform moisture and alkalinity tests and mortar bond test.

.2 Where concrete substrate exhibits higher than permitted moisture and alkalinity levels, *Provide* water vapour reduction system and repeat moisture and alkalinity tests and mortar bond tests.

.3 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.

3.3 Mixing

.1 Mix mortars, additives and grouts in accordance with manufacturer's written requirements.

3.4 Levelling Underlayment Installation

.1 Install levelling underlayment to tile flooring assemblies utilizing large format tile.

.2 Mix and apply primer to prepared subfloor. Allow to dry prior to installation of levelling material.

.3 Mix and apply levelling material in accordance with manufacturer's written requirements to produce a smooth, flat surface.

.1 Apply levelling underlayment to provide substrate surface flatness tolerances to achieve F_F 60 in accordance with ASTM E1155-14 or 3 mm (1/8") with a 3000 mm (10'-0") straightedge.

.4 Allow to set prior to installation of tile.

3.5 Sheet Waterproofing/Uncoupling Membrane Installation

.1 Levelling and sloping of substrates shall be completed prior to installation of waterproofing/uncoupling membranes.

.2 Remove dust, dirt, oil, grease, paint, laitance, efflorescence, curing compounds, sealers, water repellents and other deleterious materials that prevent bond. Metal plumbing pipe penetrations and fixtures must be clean of oil, grease, rust and other potential bond breakers.

.3 Install membranes to locations as indicated or scheduled to provide watertight performance.

.4 Install membranes to comply with ANSI A108.13 (ANSI A108/A118/A136.1-20) and manufacturer's written requirements to produce waterproof membrane of uniform thickness and bonded securely to substrate.

.5 Install prefabricated corners at outside and inside corner conditions.

.6 Install prefabricated pipe collars at penetrations.

.7 Provide strips of membrane where required to span expansion joints or terminate membrane into movement joint type tile setting accessories, in accordance with manufacturer's requirements.

.8 Seal membranes at penetrations and terminations in accordance with manufacturer's installation requirements.

.9 Floors; uncoupling/waterproofing membrane:

.1 At the joints, fill the cut-back cavities with mortar centred over membrane seams and apply additional mortar with notched trowel. Centre membrane bands over seam and embed to achieve 100% contact with mortar and substrate removing air pockets.

.2 At wall junctions apply a 250 mm (10") band strips in same manners as membrane seams.

.3 Membrane bands shall overlap uncoupling membrane seams, floor/wall transitions minimum 50 mm (2").

3.6 Installation - General

.1 Install *Products* in accordance with manufacturer's specifications and as indicated herein, in accordance with TTMAC Specification Guide 09 30 00 Tile Installation Manual TTMAC 2019-2021 Specification Guide 09 30 00, Tile Installation Manual, and in accordance with ANSI A108.5 (ANSI A108/A118/A136.1-20) except where specified otherwise.

3.7 Thin-Set Method

.1 Make joints even, straight, plumb and of uniform width.

.2 Provide mortar beds and levelling coats in accordance with TTMAC details.

.3 *Provide* uniform positive slope to floor drains, to minimum allowable slope of 20 mm/m (1/4 inch/ft).

.4 *Provide* edge protection at tile edges and corners, unless otherwise indicated, using maximum length pieces.

.5 *Provide* edge protection and transition strips at tile transitions, unless otherwise indicated, using maximum length pieces.

.6 Review locations of tile accessories with *Consultant* prior to setting tile and comply with directions of *Consultant*.

.7 Lap tile and seal with sealant at inside corners and fixtures. Caulk around pipes and openings made in tile with sealant.

.8 Apply sealant at interface with frames at openings. Apply sealant in accordance with Section 07 92 00 and manufacturer’s requirements.

.1 Sealant colour to later selection by *Consultant*.

.9 Install flooring to entire area indicated or scheduled. Unless otherwise indicated, include coverplates occurring within finished floor areas. Maintain overall uniform continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.

3.8 Tile Setting

.1 Using a damp towel, wipe off the back side of tile to remove any dust or other residue that may be left over from the manufacturing process.

.2 Place as much tile as possible in one operation before setting bed reaches initial set. Clean back and remove bed when it has set before tile is laid.

.3 Prime materials and by methods specified by manufacturer of bond coat.

.4 Except where tiles have setting tabs, and except for expansion, control and isolation joints, maintain joint widths as selected by *Consultant*.

.5 Back up tile coves, curbs and other shaped pieces solid with mortar. Rigidly set, reinforce or otherwise make firm and secure such pieces.

.6 Beat tiles in thoroughly and sufficiently to cause mortar ribs or notches to come together into a continuous void free bed and allow the mortar to flow up partially into the joint space to maximum of 1/3 the thickness of the tile. Sound floor tiles by tapping and reset all tiles with voids in setting bed.

.7 Tile shall contact setting materials for minimum of 95% coverage unless otherwise indicated.

.8 Obtain 100% mortar coverage with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108/A118/A136.1-20 series of tile installation standards for the following:

.1 Tile having any dimension 300 mm (12") or larger in any direction.

.9 Remove any excess setting material from the joint area so that 2/3 of the depth of the tile is available for grouting.

.10 Remove smudges or smears of setting material from the tile surface with a damp sponge or cloth immediately after final adjustment and beat-in while the mortar is fresh.

.11 Do necessary cutting and drilling of fixtures, fittings, and built-in or penetrating units without marring the tile. Replace all cracked or damaged tile.

.12 Form external angles with round edge tile extending over edge of square edge adjacent tile. Internal angles shall be formed square, carrying 1 flat tile past edge of other.

.13 Extend tile into recesses at windows, doors, or other openings.

.14 Extend tiles 100 mm (4") behind mirrors, and fully behind cabinets, cupboards and other fixed objects at walls.

.15 Cut tiles to conform to irregularities in wall lines and vertical planes along outer edges. Smooth cut edges with carborundum block or by other means to provide clean straight edge.

.16 Install tiles to provide even distribution of shading, colour, and characteristics.

3.9 Sealer Installation

.1 Apply 2 sealer coats in accordance with manufacturer's written installation requirements, over cleaned stone flooring surfaces (stone and grout) surfaces as scheduled in Part 2 of this section.

.1 Apply at manufacturer's recommended coverage rate, for full saturation of flooring surfaces, free of excess material.

.2 Prior to grout installation: Apply 1 sealer coat prior to application of grout. Apply over clean stone minimum of 2 hours prior to grouting.

.3 After grout installation: Apply 1 sealer coat after grouting and related clean-up. Wait prescribed time period after application of grout prior to application of sealer over stone.

.1 If 2 or more coats are applied, allow a minimum of 30 minutes drying time between coats. Remove surface residue after each application.

.2 Remove sealer that does not penetrate surface within 5 minutes of each application.

.3 Do not allow sealer to come in contact with surfaces not scheduled to receive sealer.

3.10 Trim Accessories Installation

.1 Install trims in accordance with manufacturer's written requirements.

.1 Transition trims: install in accordance with Section 09 65 13.

.2 Install in continuous lengths.

.3 Scribe and fit to obstructions.

.4 Mitre corners.

.5 Tile shall be installed flush with top surface of trim accessory with tolerance of 1 mm (1/32") lower than the top surface of trim accessory. The trim accessory shall not be higher than the tiled surface. A joint of 3 mm (1/8") shall be left between the tile and the profile to be filled with grout.

3.11 Grouting

.1 Install grout to comply with ANSI A118.4 (ANSI A108/A118/A136.1-20) unless otherwise specified and in accordance with manufacturer's written requirements.

.2 Allow tile installation to cure a minimum of 24 hours prior to grouting.

.3 Grout joints shall be free of dirt, debris, water or tile spacers and face of tiles are clean.

.4 Apply a coat of grout release and achieve 100% surface covered of tile following grout release manufacturer's written requirements.

.5 Pack joints full and free of voids/pits.

.6 Allow grout joints to become firm. Inspect joint for pinholes/voids and repair them with freshly mixed grout. Within 24 hours, check for remaining haze and remove it with warm soapy water and a nylon scrubbing pad, using a circular motion, to lightly scrub surfaces and dissolve haze/film.

.7 Grout joint width to be 6 mm (1/4"), unless otherwise indicated.

.8 Do not cover, bridge or fill any expansion joints in tile with grout.

3.12 Tile Installation Tolerances

.1 Maximum allowable lippage:

.1 Tile up to 152 mm x 152 mm (6" x 6") in size: 1 mm (0.040").

.2 Tile greater than 152 mm x 152 mm (6" x 6") in size: 2 mm (0.080").

.2 Finish planes shall be straight and plumb to within 6 mm in 3 m (1/4" in 10 feet).

3.13 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 For concrete floor substrates subject to moisture sensitive materials, conduct the following tests in accordance with the following:

.1 Test for moisture vapour transmission in accordance with ASTM F710-21 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written installation requirements. Results must not exceed the written recommendations of the product manufacturer.

.2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the product manufacturer. Test in accordance with ASTM F710-21.

.3 For each test type: Conduct 3 tests for flooring applications up to 93 m^2 (1000 square feet) in area, and 1 additional test for each additional 93 m^2 (1000 square feet) of flooring area.

.2 Adhesion bond test:

.1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.

.2 Adhesion bond test shall be completed in accordance with tile flooring and mortar setting manufacturer's written requirements and in accordance with the independent inspection and testing company's requirements.

.3 Using the specified mortar, set test tiles using mortar manufacturer's recommended trowel.

.4 After pre-determined duration, attempt to remove the test tiles by pulling up from the corners.

.2 Manufacturer shall provide field review in accordance with Section 01 45 00.

.1 Tiling system manufacturer's field representative shall be on-site and review system installation (minimum of 2 visits) during installation of the work of this section and provide written site reports to the *Consultant* certifying that the products are being installed in accordance with the warranty system requirements.

3.14 Adjusting and Cleaning

.1 Clean installed tile surfaces after grouting has cured.

.2 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.

3.15 Protection

.1 Protect work of this section against damage by work of other sections for a minimum of 72 hours after application of grouting by prohibiting passage of traffic over tile. Do not immerse in water and protect tilework from freezing for at least 28 days after installation.

.2 Protect floors from impact and vibration for a minimum of 48 hours after installation.

.3 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.

.4 Where latex or polymer additives are used in mortar materials, materials shall be cured a minimum of 14 days before exposure to moisture and before water immersion and longer as included in mortar manufacturer's written requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Acoustical tile ceiling systems (ACT-1 and ACT-2).

1.2 Administrative Requirements

.1 Coordination:

.1 Cooperate with mechanical and electrical *Subcontractors*.

.2 Coordinate layout and installation of acoustic ceiling units and suspension systems components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, partition system, fire suppression system components and other work required to be incorporated in or coordinated with the ceiling system.

.2 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Submit manufacturer's standard details.

.2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, and acoustical unit support at ceiling fixture.

.3 Submit reflected ceiling plans for special grid patterns as indicated.

.4 Samples:

.1 Submit sample of each component of ceiling system. Samples shall fully represent materials to be supplied in colour, texture, finish and construction.

.2 Submit samples, load test data and design tables for each type of insert to be used in the *Work* for hanger supports.

.5 Certificates:

.1 Submit certificate of compliance stating that the suspension system provided, including materials and installation, comply with the requirements of the *Contract Documents*.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Maintenance data:

.1 Submit maintenance and cleaning instructions for acoustical ceiling systems for incorporation into the maintenance manuals.

.3 Maintenance materials:

.1 Deliver for maintenance use, 2% of each type and colour of suspension components and acoustical tiles used in the *Work*.

.2 Pack panels in suitable containers, clearly dated and identified as to type and location of installation in the *Work*, and store where directed by *Owner*.

1.5 Quality Assurance

.1 Qualifications:

.1 Installers / applicators / erectors:

.1 Installers: Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

.2 Mock-ups:

.1 Construct in locations acceptable to *Consultant* a typical sample ceiling installation. Modify sample as directed and as required to obtain approval. Upon acceptance retain sample as standard of quality for acoustical ceiling.

.2 Do not begin fabrication and erection of remainder of ceiling system until sample installation has been reviewed and accepted. Accepted sample may become a part of the final *Work*, subject of approval of *Consultant*.

1.6 Delivery, Storage, and Handling

.1 Ship exposed members and mouldings in rigid crates to avoid damage. Bent or deformed material shall be rejected. Baked enamelled members shall be suitably wrapped and protected against damage.

.2 Deliver acoustical ceiling units to the *Place of the Work* in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

.3 Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.

.4 Handle acoustical ceiling units carefully to avoid chipping edges or damaging units.

1.7 Field Conditions

.1 Commence installation after building is enclosed with windows and exterior doors in place and glazed, and roof watertight.

.2 Interior temperature of building to range from 15°C to 30°C and relative humidity of not more than 70% before and during installation. Maintain uniform temperatures for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Design suspension systems for a maximum mid-span deflection not exceeding L/360 in accordance with ASTM C635/C635M-17 deflection test.

.2 Design suspension system to support safely, and without distortion, the superimposed loads of:

.1 Air supply diffusers and return grilles.

.2 Lighting fixtures.

2.2 General

.1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.3 Acoustical Tiles

.1 Lay-in acoustical tiles (ACT-1 and ACT-2):

.1 Classification: Type IV, Form 2, Pattern E in accordance with ASTM E1264-22.

.2 NRC: 0.80.

.3 Flame spread:

.1 Maximum values in accordance with CAN/ULC-S102-10:

.1 Flame Spread Value (FSV): 25.

.2 Smoke Developed Value (SDV): 50.

.4 Acceptable *Products*, size, edge, colour: Refer to Material Legend.

.5 Substitutions: in accordance with Section 01 25 00.

2.4 Metal Suspension Systems

.1 Hanger anchorage devices: Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.

.2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, a load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M-22, conducted by a qualified independent testing laboratory.

.1 Dynabolt Sleeve Anchor 'TW-1614' or Readi-Tie-Drive 'TD4-112' tie wire anchor by ITW Ramset/Red Head.

.2 Kwik-Bolt III 'HHDCA 1/4' tie wire anchor by Hilti Corporation.

.3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.

.3 Hangers and tie wire: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm (0.1") (12 gauge).

.4 Suspension system accessories:

.1 Splices, clips, and perimeter moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified.

.5 Standard suspension system, non fire-rated:

.1 Heavy duty in accordance with ASTM C635/C635M-17, 24 mm (15/16") interlocking tee system, designed to support acoustical panels in patterns indicated with deflection of main tees less than L/360, consisting of main tees and cross tees. The system shall provide lock joint intersections of cross and main tees.

.2 Acceptable *Products*: Refer to Material Legend.

2.5 Miscellaneous Materials

.1 Acoustical sealant: Non-drying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant complying with requirements specified in Section 07 92 00.

2.6 Metal Finish

.1 Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing colour. Submit 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.

.1 Colour: Flat white.

PART 3 - EXECUTION

3.1 Installation - General

.1 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with *Contract Documents*, notify *Consultant* before proceeding with installation.

.2 Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.

3.2 Installation - Suspension System

.1 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636/C636M-19, CISCA installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.

.2 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.

.3 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.

.4 Space hangers for ceilings at maximum 1220 mm (48") on centre in both directions. Provide additional hangers as required to comply with manufacturer's written installation requirements.

.5 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.

.6 Exposed tees shall be as long as possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.

.7 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.

.8 Cooperate in the installation of ceiling systems, making adjustments where required to ensure that the lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.

.9 Restrict creep inside module panels so that in all cases strips are centred on module lines.

.10 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.

.1 Screw attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system. Lap corners accurately and connect securely.

3.3 Installation - Tiles

.1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.

.2 Minimize field cutting. Rectify cut tile edges of tile to match factory cut edge profile and colour.

.3 Install acoustical tiles to form horizontal and level ceiling with all parts flush and joints butted tightly to hairline appearance.

.4 Distribute variations in colour and texture of panels to obtain a uniform appearance.

3.4 Installation - Tolerances

.1 Allowable tolerances: in accordance with ASTM C636/C636M-19.

.2 Install suspension systems level to tolerance of 1:1200.

.3 Install edge mouldings level to tolerance of 3 mm in 3660 mm (1/8" in 12'-0").

3.5 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00 and as follows:

3.6 Adjusting and Cleaning

.1 Replace uneven, defective or damaged materials and finishes, eliminate waves, remove soiled or stained areas.

.2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Resilient base (RB-1 and RB-2).

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Samples:

.1 Samples for verification: Submit 3 samples of the following:

.1 305 mm (12") long samples of each colour and type of base material. Include sample of outside corner of base.

.4 Test and evaluation reports:

.1 Submit moisture, alkalinity, and adhesive bond test results.

.5 Manufacturer's instructions:

.1 Submit manufacturer's installation instructions for *Products* proposed for use in the work of this section.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

.1 Qualifications:

.1 Installers:

.1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

.2 Mock-up:

.1 Resilient base mock-up shall include at least one inside corner, one outside corner plus 20 m (65'-0") of straight run.

.2 Resilient base mock-up on poplar base (B-3) at columns.

.3 Refer to location indicated on the drawings.

PART 2 - PRODUCTS

2.1 General

.1 Single source responsibility: Obtain each type of resilient *Product* from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the *Work*. Products installed as part of the work of this section shall be from same production run.

2.2 Resilient Base

.1 Rubber base types:

.1 Manufactured from thermoplastic rubber formulation meeting ASTM F1861-16, Type TP, Group 1 (Solid).

.2 Rubber base; wall base (RB-1 and RB-2):

.1 Acceptable *Product*s: Refer to Material Legend.

2.3 Accessories

.1 Block wall filler: Filler type as recommended by resilient base manufacturer to suit substrate and compatible with materials.

.2 Concrete patching and levelling compound:

.1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.

.2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-21.

.3 Gypsum based compounds are not acceptable.

.4 Acceptable manufacturers:

.1 Ardex.

.2 Mapei.

.3 Substitutions: in accordance with Section 01 25 00.

.5 Acceptable *Product*: type as recommended by resilient product manufacturer for substrate conditions.

.3 Primers and adhesives: Types as recommended by resilient product manufacturer compatible with materials and to suit substrate types.

.4 Sealant:

.1 Medium-modulus, neutral-curing silicone sealant; complying with ASTM C920-14, Type S, Grade NS.

.2 Colour: Clear.

.3 Acceptable Manufacturers:

.1 Dowsil.

.2 Momentive.

.3 Tremco.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that field conditions have been provided as requested and specified.

.2 Substrates shall be firm, structurally sound, sufficiently porous, and dry.

.3 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.

.4 Examine substrates in advance of application of products to ensure that substrates are protected against entry of water and moisture.

.5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

.6 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

.7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

.1 Substrates shall be free of deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.

.2 Fill gaps, voids, and cracks, and remove ridges, or other defects which will ghost or telegraph through finished product installation.

.3 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.

.4 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.

.5 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.

.6 Alkalinity, moisture, and adhesion bond testing:

.1 Perform moisture and alkalinity tests and adhesive bond test.

.2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.

.7 Do not install products until they are same temperature as space where they are to be installed.

.8 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.

.9 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.

.10 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the resilient material or used to mark the substrate as they could bleed through and permanently stain the resilient material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the resilient material.

3.3 Installation of Resilient Base

.1 Spread adhesive to ribbed surface (back) of wall base with a 3 mm (1/8") square-notched trowel; allow slight set-up, then bring base into contact with substrate. Ensure full adhesion of base to substrate. Adhesive should cover 80% of back surface. Leave a 6 mm (1/4") uncovered space at the top of the wall base to prevent the adhesive from oozing onto the wall above the base when installed.

.2 Position wall base on wall surface and roll with hand roller. Always roll back to starting point to prevent stretching the wall base.

.3 Set base to ensure installation over finished flooring material is free of gaps.

.4 Install base in longest lengths possible, minimum 2440 mm (8’). Adhere toe of base to substrate, and ensure edge of toe is straight.

.5 Scribe and fit to door frames and other obstructions.

.6 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.

.7 *Provide* joints in base over substrate control joints.

.8 Install factory preformed inside corners.

.9 Install factory preformed outside corners.

3.4 Installation Tolerances

.1 Resilient base: Install straight and level to variation of 3 mm (1/8") over 3 m (10’-0”).

3.5 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 Moisture and alkalinity:

.1 Test for moisture and alkalinity in accordance with product manufacturer’s written requirements.

.2 Adhesion bond test:

.1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.

.2 Adhesions tests shall be completed in accordance with product manufacturer’s written requirements.

.2 Manufacturer’s field review to be in accordance with Section 01 45 00.

3.6 Adjusting and Cleaning

.1 Remove adhesive from surfaces as work progresses in manner described by manufacturer.

.2 Thoroughly clean surfaces in accordance with manufacturer's written requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Vinyl sheet flooring (RFL-2).

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Show sheet flooring roll and width layout as related to *Consultant's* floor pattern including borders and accents including where flooring materials meet other floor materials.

.2 Show locations of seams, floor drains, floor plates, and where flooring meets other flooring.

.4 Samples:

.1 Samples for verification:

.1 Submit sample of vinyl sheet flooring, minimum 150 mm (6") x 150 mm (6") of each different colour and pattern of vinyl sheet flooring.

.2 Submit sample of heat-welding bead, minimum 150 mm (6") length of each colour.

.3 Submit seam samples for each vinyl sheet flooring product and colour with heat-welded seam. Sample shall be a minimum of 150 mm (6") x 254 mm (10") and shall be adhered to a rigid backing material with the seam running lengthwise and in the center of the sample.

.5 Test and evaluation reports:

.1 Submit moisture, alkalinity, and adhesive bond test results.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

.3 Maintenance materials:

.1 Submit width of material 2% of each colour in full running length, pattern and type flooring material required for this project for maintenance use.

.2 Maintenance materials to be same production run as installed materials.

.3 Suitably package for protection and storage, each identified with name of manufacturer and flooring material.

.4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

.1 Qualifications:

.1 Installers:

.1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

.2 Mock-ups:

.1 Prior to commencing flooring installation for this section, prepare mock-up minimum 1220mm x 1220mm (4' x 4') in location indicated on the drawings.

.2 Mock-up shall include flooring showing edge treatment and relationships to adjoining surfaces.

.3 Do not proceed with flooring specified in this section until mock-up has been accepted by *Contractor* and *Consultant*.

1.6 Delivery, Storage, and Handling

.1 Package flooring materials and identify contents of each package.

.2 Store materials for a minimum of 24 hours immediately before installation to comply with temperatures specified under Field Conditions.

.3 Store flooring rolls on end.

1.7 Field Conditions

.1 Ambient conditions:

.1 Install materials of this section only when surfaces and air temperatures have been maintained between 18.4°C (65°F) and 29.4°C (85°F) for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C (55°F) after above period. Relative humidity shall be 50 +/- 10%.

.2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

.3 In areas that are exposed to intense or direct sunlight, *Products* shall be protected during the conditioning, installation, and adhesive curing periods, by covering the light source.

.4 Allow products to acclimatize in installation area for a minimum 24 hour prior to installation.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.

.2 Vinyl sheet flooring shall not:

.1 Become stained or discoloured due to slab markings.

.2 Delaminate from substrates.

.3 Have welded seams which separate.

2.2 General

.1 Single source responsibility: Obtain each product from a single source with resources to provide products of consistent quality in appearance and physical properties, same production run. Products installed as part of the work of this section shall be from same production run.

2.3 Vinyl Sheet Flooring

.1 Vinyl sheet flooring (RFL-2):

.1 Heterogeneous vinyl sheet flooring with fibreglass.

.2 In accordance with ASTM F1303-04(2021), Type I, Grade 1.

.3 Overall thickness: 2.2 mm (0.087”)

.4 Colour and finish: as indicated on drawings.

.5 Acceptable *Products*: Refer to Material Legend.

2.4 Miscellaneous Materials

.1 Seam construction:

.1 Hot welded joints, provide welding rod matched to floor pattern/colour selected.

.2 Colours: To later selected by *Consultant* from full colour range.

.2 Primer/adhesives:

.1 Types designed for wet areas as recommended by resilient flooring manufacturer compatible with materials and to suit substrate types and to comply with warranty requirements.

.3 Patching and levelling compound:

.1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.

.2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-21 or ASTM C472.

.3 Gypsum based compounds are not acceptable.

.4 Acceptable manufacturers:

.1 Ardex.

.2 Mapei.

.3 Substitutions: in accordance with Section 01 25 00.

.5 Acceptable *Product*: type as recommended by flooring manufacturer.

.4 Cleaning solution:

.1 Acceptable *Products*: type as recommended by flooring manufacturer.

.5 Floor transition strips: as indicated on drawings.

.6 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that field conditions have been provided as requested and specified.

.2 Verify that substrates have been provided as specified without holes, protrusions, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3 mm (1/8") deep, or other major defects.

.3 Substrates shall be firm, structurally sound, sufficiently porous, and dry.

.4 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.

.5 Examine floors in advance of application of flooring to ensure that floors are protected against entry of water and moisture. Perform compatibility test with primer/adhesive and substrate.

.6 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

.7 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

.8 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

.1 Comply with recommendations of ASTM F710-21.

.2 Substrates shall be free of wax, oil, silicone, soap, grease, dust, solvents, sealers, curing compounds, hardeners, alkaline salts, excessive carbonation or laitance, mould, mildew, paints, varnish, asphalt, residual adhesives, adhesive removers, or other contaminants or deleterious material that my inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.

.3 Concrete substrates that are loose, sandy, scaly, or have a white powdery surface are not acceptable. Substrates shall be mechanically prepared.

.4 Flooring substrates shall be smooth and level within a tolerance of 3 mm (1/8") in a 3 m (10’-0") radius.

.5 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.

.6 At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide trowel-applied levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper trowel-applied levelling compound to transition with adjacent flooring substrate to provide smooth and seamless transition at maximum slope of 3:1000 (height to distance) ratio.

.7 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.

.8 Remove bumps, high spots, peaks and ridges to produce a uniform and smooth substrate.

.9 Prepare substrates so that installation of flooring shall not show telegraphing of substrate.

.10 Remove chalking and dusting and loose material from concrete surfaces with wire brushed or by scraping.

.11 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.

.12 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.

.13 Alkalinity, moisture, and adhesion bond testing:

.1 Test substrates in accordance with paragraph 3.5 Field Quality Control after mechanically preparing subfloor or applying patching and levelling compounds.

.2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.

.14 Do not install floor coverings until they are same temperature as space where they are to be installed.

.1 Move floor coverings and installation materials to acclimatize in spaces where they will be installed at least 48 hours in advance of installation.

.15 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.

.16 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials to achieve flush floor finish between adjacent flooring materials unless otherwise indicated.

.17 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.

3.3 Flooring Installation

.1 Verify product type, size, thickness, and colour prior to commencing installation. Do not install flooring with visual imperfections, colour variations or apparent defects.

.2 Allow material to relax unrolled overnight, minimum 12 hours in installation areas.

.3 Install rolls and cuts in sequence following manufacturer's installation requirements/diagrams.

.1 Lay flooring with joints parallel to building lines to produce symmetrical pattern and minimum joints.

.2 Place seams in inconspicuous and low-traffic areas, at least 150 mm (6") away from parallel joints in levelling underlayment, concrete joints, saw cuts and other type of joints.

.3 Avoid cross seams.

.4 Lay sheet flooring centered in corridors, with equal sized sheet to either side of center sheet.

.5 Mitre intersections at corridors typically. "T" type corridors shall be butt type installation.

.6 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

.7 Layout seaming uniformly, using full length flooring typically, minimum flooring size of not less than roll width. Limit quantity of less than full length floor pieces at corridors to maximum of 1.

.8 Layout flooring to match reviewed shop drawings floor pattern including borders and accents.

.9 Match edges of floor coverings for colour shading at seams.

.4 Cutting and fitting sheets:

.1 Cut pieces to length allowing approximately 75 mm (3") to 150 mm (6") excess for trimming.

.2 Remove 12.7 mm (1/2") off the factory seam edge using an edge trimmer or straight edge and knife.

.3 Cut sheet and fit neatly around fixed objects without gaps.

.4 Position remaining sheets so that the top sheet overlaps the previous sheet by 12.7 mm (1/2") to 19 mm (3/4").

.5 Install one sheet at a time in wet adhesive.

.6 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.

.7 After the material has been laid and rolled in wet adhesive, underscribe the seam using the short scribes with a scribed pin right away.

.8 Cut the material along the scribe line using a hooked blade knife and holding it at an angle so to slightly undercut the material.

.9 Roll the seam with a hand roller.

.10 Cross seams:

.1 Straight edge and undercut at an angle the end of the first sheet.

.2 Spread adhesive and lay in wet adhesive.

.3 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.

.4 Overlap the second sheet at butt seam approximately 25 mm (1").

.5 Adhere second sheet except for last 450 mm (18") of butt seam; wait 20 – 30 minutes.

.6 Spread the adhesive for the last 450 mm (18"), lay in material, underscribe the seam to a neat, fit cut, and roll flooring immediately in both directions using 45 kg (100 lb) three-section roller.

.5 Install drain clamping rings.

.6 As installation progresses, roll flooring with 45 kg (100 lb) three-section roller to ensure full adhesion, remove adhesive ridges, and entrapped air.

.7 Where cove base is not required, seal joint at wall with manufacturer's approved sealant.

.8 Apply adhesive uniformly and at spreading rates in accordance with adhesive manufacturer's requirements. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.9 Obtain 100% adhesive coverage to flooring backing.

.10 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Cut flooring to floor drains occurring within finished floor areas.

.11 Heat-welded seams:

.1 Weld seams in accordance with ASTM F1516-13(2018).

.2 Wait minimum of 24 hours after flooring installation before grooving and heat welding seams.

.3 Prepare, weld, and trim seams to produce flat surfaces flush with adjoining floor covering surfaces.

.4 Rout joints to approximately 2/3 of the thickness of the material and use welding bead to permanently fuse sections into a seamless floor covering. Groove shall be between 3 mm (0.118") and 3.5 mm (0.138") wide.

.5 Using a weld plate and skiving knife to make first cut and allow weld rod to fully cure to room temperature.

.6 Using a skiving knife only, finish the trimming of the remainder of the weld. The finish should be smooth and on the same level as the flooring.

.7 Trimming of welded joint while warm is not permitted unless final trimming is performed after weld has cooled to flooring temperature. Excess weld shall be removed using a heated standard putty knife.

.8 Roll the seam area with 45 kg (100 lb) three-section roller.

.9 Maximum variation of welds from plane or from straight: 6 mm (1/4") in 3 m (10 ft) length using a 3 m (10 ft) straight edge.

.12 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

3.4 Installation - Transition Trim

.1 Protect exposed edges of flooring, where finished and unfinished areas adjoining, by means of a transition trim butting to and flush with the finished surface of the flooring covering material and securely adhered to the substrate material.

.2 Coordinate transitions with work of other sections.

.3 Allow coiled vinyl material to lay flat for at least 24 hours at ambient temperatures specified above prior to installation.

.4 Set to ensure installation is free of gaps.

.5 Install in longest lengths possible.

.6 Install straight to maximum allowable variation of 3 mm (1/8") over 3 m (10’-0").

.7 Scribe and fit to obstructions.

.8 Fit joints tightly, straight and vertical as applicable and not less than 610 mm (24") from corners.

.9 Mitre corners.

3.5 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 Moisture and alkalinity:

.1 Test for moisture vapour transmission in accordance with ASTM F710-21 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer’s written flooring installation requirements. Results must not exceed 170 µg/m² (3 lb per 1,000 ft²) in 24 hours when tested to ASTM F1869-22, or exceed 75% when tested to ASTM F2170-19a.

.2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-21.

.3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 ft²) in area, and 1 additional test for each additional 93 m² (1000 ft²) of flooring area.

.2 Adhesion bond test:

.1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.

.2 Select six substrate test areas, each 915 mm (3’-0”) x 915 mm (3’-0”) in size. Test areas shall be spaced a minimum 1220 mm (48") apart.

.3 Cut 915 mm (3’-0”) x 915 mm (3’-0”) panels from specified material.

.4 Using the specified adhesive, glue down each panel using adhesive manufacturer's recommended trowel.

.5 After 72 hours, attempt to remove the panels of flooring by pulling up from the corners.

.2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.6 Adjusting and Cleaning

.1 Remove excess adhesive from surfaces of the sheet flooring as work progresses.

.2 Thoroughly clean surfaces in accordance with manufacturer's recommendations.

.3 Only use materials and products recommended by flooring manufacturer to remove excess adhesive.

3.7 Protection

.1 Prohibit foot traffic on installed flooring for a period of 24 hours after installation. No heavy traffic, rolling loads, or furniture placement are permitted for a minimum of 72 hours after installation.

.2 Protect new floors from time of final set of adhesive until final inspection.

.3 Install floor protection in areas where work, repairs and installation of equipment, and foot traffic will occur.

3.8 Maintenance

.1 Perform initial maintenance according to the manufacturer's written requirements.

.2 Dust mop and vacuum flooring.

.3 Allow flooring to dry prior to applying protection.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Linoleum sheet flooring (RFL-1).

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer’s *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Samples:

.1 Samples for verification:

.1 Flooring: In manufacturer's standard size, but not less than 150 mm (6") x 230 mm (6” x 9”) sections of each different colour and pattern of floor covering required.

.2 Heat-welding bead: Manufacturer's standard-size samples, but not less than 230 mm (9”) long, of each colour required.

.3 Seam samples: For each floor covering product, colour, pattern, and seam required, installer shall *Provide* a 150 mm x 230 mm (6” x 9”) sample directly applied to a rigid backing material with the seam running lengthwise and in the center of the sample.

.4 Test and evaluation reports:

.1 Submit moisture, alkalinity, and adhesive bond test results.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer’s operation and maintenance instructions for inclusion in the operation and maintenance manuals.

.3 Maintenance materials:

.1 Submit 2% of each colour in full running length, pattern and type flooring material required for this project for maintenance use.

.2 Maintenance materials to be same production run as installed materials.

.3 Suitably package for protection and storage, each identified with name of manufacturer and flooring material.

.4 Tag and store where directed by *Owner*.

1.5 Quality Assurance

.1 Qualifications:

.1 Installers:

.1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

.2 Mock-ups:

.1 Prior to commencing flooring installation for this section, prepare mock-up minimum 1220mm x 1220mm (4' x 4') in location indicated on the drawings.

.2 Mock-up shall include flooring showing edge treatment and relationships to adjoining surfaces.

.3 Do not proceed with flooring specified in this section until mock-up has been accepted by *Contractor* and *Consultant*.

1.6 Delivery, Storage, and Handling

.1 Package flooring materials and identify contents of each package.

.2 Store materials for a minimum of 24 hours immediately before installation to comply with temperatures specified under Field Conditions.

.3 Store flooring rolls on end.

1.7 Field Conditions

.1 Ambient conditions:

.1 Install materials of this section only when surfaces and air temperatures have been maintained between 18.4°C (65°F) and 29.4°C (85°F) for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C (55°F) after above period. Relative humidity shall be 50 +/- 10%.

.2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

.3 In areas that are exposed to intense or direct sunlight, *Products* shall be protected during the conditioning, installation, and adhesive curing periods, by covering the light source.

.4 Allow products to acclimatize in installation area for a minimum 24 hour prior to installation.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.

.2 Linoleum sheet flooring shall not:

.1 Become stained or discoloured due to slab markings.

.2 Delaminate from substrates.

.3 Have welded seams which separate.

2.2 General

.1 Single source responsibility: Obtain each product from a single source with resources to provide products of consistent quality in appearance and physical properties, same production run. Products installed as part of the work of this section shall be from same production run.

2.3 Linoleum

.1 Linoleum sheet flooring (RFL-1):

.1 In accordance with ASTM F2034-18, Type 1, colours and pattern detail shall be dispersed throughout the thickness of the wear layer.

.2 Thickness: 3.5 mm (0.138”).

.3 Acceptable *Products*: Refer to Material Legend.

2.4 Miscellaneous Materials

.1 Seam construction:

.1 Hot welded joints, provide welding rod matched to floor pattern/colour selected.

.2 Colours: To later selected by *Consultant* from full colour range.

.2 Primers and adhesives:

.1 Types designed for wet areas as recommended by resilient flooring manufacturer compatible with materials and to suit substrate types and to comply with warranty requirements.

.2 Adhesives shall be appropriate for equipment, cart, and patient bed/stretcher rolling load traffic where applicable.

.3 Patching and levelling compound:

.1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.

.2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-21.

.3 Gypsum based compounds are not acceptable.

.4 Acceptable manufacturers:

.1 Ardex.

.2 Mapei.

.3 Substitutions: in accordance with Section 01 25 00.

.5 Acceptable *Product*: type as recommended by flooring manufacturer for substrate conditions.

.4 Cleaning solution:

.1 Acceptable *Products*: type as recommended by flooring manufacturer.

.5 Floor transition strips: as indicated on the drawings.

.6 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that field conditions have been provided as requested and specified.

.2 Verify that substrates have been provided as specified without holes, protrusions, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3 mm (1/8") deep, or other major defects.

.3 Substrates shall be firm, structurally sound, sufficiently porous, and dry.

.4 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.

.5 Examine floors in advance of application of flooring to ensure that floors are protected against entry of water and moisture.

.6 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

.7 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

.8 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

.1 Comply with recommendations of ASTM F710-21.

.2 Substrates shall be free of wax, oil, silicone, soap, grease, dust, solvents, sealers, curing compounds, hardeners, alkaline salts, excessive carbonation or laitance, mould, mildew, paints, varnish, asphalt, residual adhesives, adhesive removers, or other contaminants or deleterious material that my inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.

.3 Concrete substrates that are loose, sandy, scaly, or have a white powdery surface are not acceptable. Substrates shall be mechanically prepared.

.4 Flooring substrates shall be smooth and level within a tolerance of 3 mm (1/8") in a 3 m (10’-0”) radius.

.5 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.

.6 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.

.7 Remove bumps, high spots, peaks and ridges to produce a uniform and smooth substrate.

.8 Prepare substrates so that installation of flooring shall not show telegraphing of substrate.

.9 Remove chalking and dusting and loose material from concrete surfaces with wire brushed or by scraping.

.10 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.

.11 Notify *Consultant* of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.

.12 Alkalinity, moisture, and adhesion bond testing:

.1 Test substrates in accordance with paragraph 3.4 Field Quality Control after mechanically preparing subfloor or applying patching and levelling compounds.

.2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to *Consultant*.

.13 Do not install floor coverings until they are same temperature as space where they are to be installed.

.1 Move floor coverings and installation materials to acclimatize in spaces where they will be installed at least 48 hours in advance of installation.

.14 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials to achieve flush floor finish between adjacent flooring materials unless otherwise indicated.

.15 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.

3.3 Sheet Flooring Installation

.1 Before commencing installation, verify product type, size, thickness, and colour. Do not install flooring with visual imperfections, colour variations or apparent defects.

.2 Install rolls and cuts in sequence by roll number and cuts from each individual roll in consecutive order. Do not reverse sheets for seaming.

.3 Unroll material in the same direction and follow the flooring manufacture’s numbered sequence/layout diagram.

.1 Lay flooring with joints parallel to building lines to produce symmetrical pattern and minimum joints.

.2 Place seams in inconspicuous and low-traffic areas, at least 150 mm (6") away from parallel joints in floor covering substrates.

.3 Avoid cross seams.

.4 Lay sheet flooring centered in corridors, with equal sized sheet to either side of center sheet.

.5 Mitre intersections at corridors typically. “T” type corridors shall be butt type installation.

.6 Layout seaming uniformly, using full length flooring typically, minimum flooring size of not less than roll width. Limit quantity of less than full length floor pieces at corridors to maximum of 1.

.7 Layout flooring to match reviewed shop drawings floor pattern including borders and accents.

.8 Match edges of floor coverings for colour shading at seams.

.4 Allow material to relax overnight, minimum 12 hours in installation areas.

.5 Cutting and fitting sheets:

.1 Cut pieces to length allowing approximately 75 mm (3") to 150 mm (6") excess for trimming.

.2 Remove 12.7 mm (1/2") off the factory seam edge using an edge trimmer or straight edge and knife.

.3 Seams shall be a minimum of 150 mm (6") away from levelling underlayment and concrete joints, saw cuts and other type of joints.

.4 Cut sheet and fit neatly around fixed objects without gaps.

.5 Position remaining sheets so that the top sheet overlaps the previous sheet by 12.7 mm (1/2") to 19 mm (3/4").

.6 Install one sheet at a time in wet adhesive.

.7 Roll the flooring immediately in both directions using a clean, 45 kg (100 lb) three-section roller.

.8 After the material has been laid and rolled in wet adhesive, underscribe the seam using the short scribes with a scribed pin right away.

.9 Cut the material along the scribe line using a hooked blade knife and holding it at an angle so to slightly undercut the material.

.10 Roll the seam with a hand roller.

.11 Cross seams:

.1 Straight edge and undercut at an angle the end of the first sheet.

.2 Spread adhesive and lay in wet adhesive.

.3 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.

.4 Overlap the second sheet at butt seam approximately 25 mm (1").

.5 Adhere second sheet except for last 450 mm (18") of butt seam; wait 20 – 30 minutes.

.6 Spread the adhesive for the last 450 mm (18"), lay in material, underscribe the seam to a neat, fit cut, and roll flooring immediately in both directions using 45 kg (100 lb) three-section roller.

.6 Apply adhesive uniformly and install flooring in accordance with flooring manufacturer's requirements. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.7 Obtain 100% adhesive coverage to flooring backing.

.8 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Cut flooring to floor drains occurring within finished floor areas.

.9 Terminate flooring at centerline of door in openings where there is an adjacent floor finish or colour is dissimilar unless otherwise indicated or scheduled.

.10 Centreline of transition should coincide with centreline of door.

.11 Heat-welded seams:

.1 Weld seams in accordance with ASTM F1516-13(2018).

.2 Wait minimum of 24 hours after flooring installation before grooving and heat welding seams.

.3 Prepare, weld, and trim seams to produce flat surfaces flush with adjoining floor covering surfaces.

.4 Rout joints to approximately 2/3 of the thickness of the material and use welding bead to permanently fuse sections into a seamless floor covering. Groove shall be between 3 mm (0.118") and 3.5 mm (0.138”) wide.

.5 Using a weld plate and skiving knife to make first cut and allow weld rod to fully cure to room temperature.

.6 Using a skiving knife only, finish the trimming of the remainder of the weld. The finish should be smooth and on the same level as the flooring.

.7 Trimming of welded joint while warm is not permitted unless final trimming is performed after weld has cooled to flooring temperature. Excess weld shall be removed using a heated standard putty knife.

.8 Roll the seam area with 45 kg (100 lb) three-section roller.

.9 Maximum variation of welds from plane or from straight: 6 mm (1/4”) in 3 m (10 ft) length using a 3 m (10 ft) straight edge.

.12 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

3.4 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 Moisture and alkalinity:

.1 Test for moisture vapour transmission in accordance with ASTM F710-21 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 µg/m² (3 lb per 1,000 ft²) in 24 hours when tested to ASTM F1869-22, or exceed 75% when tested to ASTM F2170-19a.

.2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-21.

.3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 ft²) in area, and 1 additional test for each additional 93 m² (1000 ft²) of flooring area.

.2 Adhesion bond test:

.1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.

.2 Select six substrate test areas, each 915 mm (3'-0") x 915 mm (3'-0") in size. Test areas shall be spaced a minimum 1220 mm (48") apart.

.3 Cut 915 mm (3'-0") x 915 mm (3'-0") panels from specified material.

.4 Using the specified adhesive, glue down each panel using adhesive manufacturer's recommended trowel.

.5 After 72 hours, attempt to remove the panels of flooring by pulling up from the corners.

.2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.5 Adjusting and Cleaning

.1 Remove excess adhesive from surfaces of the sheet flooring as work progresses.

.2 Only use materials and products recommended by flooring manufacturer to remove excess adhesive.

3.6 Protection

.1 Prohibit foot traffic on installed flooring for a period of 24 hours after installation. No heavy traffic, rolling loads, or furniture placement are permitted for a minimum of 72 hours after installation.

.2 Protect new floors from time of final set of adhesive until final inspection.

.3 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.

3.7 Maintenance

.1 Perform initial maintenance according to the manufacturer's written requirements.

.2 Allow flooring to dry prior to applying protection.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Epoxy flooring (EP-1).

1.2 Administrative Requirements

.1 Coordination:

.1 Advise other trades of fixtures and fittings not to be installed until floor coating materials are cured, such as: radiators, painting, decorating, floor-supported equipment or cabinetwork, caulking, plumbing, fixtures, and the like.

.2 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Submit shop drawings showing proposed divider strips and start / stop installation lines. Coordinate locations with slab control joints. Lay out divider strips symmetrically in rooms.

.4 Samples:

.1 Submit 305 mm x 305 mm (12" x 12") samples of each specified material, in each specified colour to show successive applications of each coat for *Consultant's* approval.

.2 Submit 305 mm x 305 mm (12" x 12") sample of completed system on rigid backing, demonstrating texture and broadcast aggregate, colour, and sheen, for *Consultant's* approval.

.5 Manufacturers' instructions:

.1 Submit substrate preparation guidelines, installation instructions, and general recommendations.

.6 Submit for approval a list of the floor coating materials intended for use in the *Work* for each substrate condition before installation commences.

.7 Include sample of warranty customized for this Project.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

.2 Submit manufacturer's list of acceptable cleaning chemicals for each epoxy floor and wall system specified in this section.

1.5 Quality Assurance

.1 Qualifications:

.1 Manufacturers:

.1 Company specializing in manufacturing the *Products* specified in this section, with 10 years' experience, minimum.

.2 Installers / applicators / erectors:

.1 Applicators: Shall have 5 years' experience, minimum, in application of *Products* and systems specified and with approval and training of *Product* manufacturers.

.2 *Subcontractor* must be approved by the flooring system manufacturer. Submit *Subcontractor's* certification letter prepared by the flooring system manufacturer.

.3 Execute work of this section only under full time supervision of qualified *Subcontractor's* site supervisor.

.2 Mock-ups:

.1 *Provide* mock-up panel minimum 1220 mm x 1220 mm (4' x 4') of coating system at the *Place of the Work* as part of final installation for approval by *Consultant*, location to be determined by *Consultant*. Mock-up will serve as a benchmark for installation of the system for the *Work*.

.2 Construct mock-up at the *Place of the Work* of cove base at door frames.

1.6 Field Conditions

.1 Ambient conditions:

.1 Unless required otherwise by manufacturer's installation requirements maintain ambient temperature of not less than 13°C (55°F) and below 32°C (90°F), and a floor temperature of not less than 16°C (60°F) from 24 hours before installation to at least 72 hours after installation. Maintain relative humidity of not higher than 80% during same period.

.2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

1.7 Delivery, Storage, and Handling

.1 Deliver materials to the *Place of the Work* in sealed undamaged containers clearly labelled with name and batch number.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Material compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.

.2 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.

2.2 General

.1 Installation of systems specified in this section to be by a single *Subcontractor*.

.2 Materials shall be sourced from one manufacturer unless otherwise specified.

2.3 Fluid-Applied Epoxy Flooring (SF-3)

.1 Self-levelling 100% solids epoxy coating system, consisting of primer, body coat including finely graded aggregate, and top coat, complete with integral cove base.

.1 Broadcast at flooring, trowelled base.

.2 Acceptable *Products*: Refer to Material Legend.

.3 Colour: as selected by *Consultant*.

.4 Texture: non-slip, as selected by *Consultant*.

.5 Trowel mortar type.

.1 Master Builders Solutions Canada 'Mastertop 1235SL'.

.2 Neogard ‘WG-250’.

.3 Sika ‘Morritex Broadcast System/Morritex Epoxy Cove Mortar System’.

.2 Substitutions: in accordance with Section 01 25 00.

.3 Termination strips: ‘L’ shape zinc x depth of coating.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that specified field conditions are ensured before commencing the work of this section.

.2 Examine surfaces to receive floor coatings. Surfaces shall be smooth, sound, dry, and free from conditions that will adversely affect execution, permanence, or quality of work.

.3 Verify that surfaces to receive coatings can be put into acceptable condition by means of preparation specified in this section.

.4 Floor surfaces to receive coating shall be equivalent to a light steel trowel finish for new or patched concrete surface.

.5 Examine floor surfaces to be coated for slope to drain irregularities which could create non-sloping or ponding conditions on the epoxy coating surface.

.6 Verify that floor drains are installed flush with top of floor slabs.

.7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

.8 Commencement of installation implies acceptance of surfaces as suitable to receive coating system.

3.2 Preparation

.1 After acceptance of surfaces, prepare them as required to receive the work of this section. Remove projections and other conditions that may affect the installation of the flooring system.

.2 Concrete slabs shall have sound surface free of dust, chemicals, grease, oil, laitance and curing agents.

.3 Remove curing compounds, surface hardeners, existing flooring adhesives, and epoxy flooring coatings in accordance with manufacturer's written recommendations.

.4 Fill open control joints, and other cracks and voids with sealant material compatible with floor coating materials.

.5 Remove projections and other conditions which may affect installation of the coating.

.6 Repair surface spalls and imperfections with patching compound approved by manufacturer.

.7 Test surfaces for moisture content to verify that they are suitable for application, and fully cured. Check moisture content of concrete using a Delmhorst moisture meter. Moisture content shall be within the limits set by the coating manufacturer prior to commencing work.

.8 Prepare concrete surfaces by mechanical method of steel shotblast, sandblast, or other method approved by coating manufacturer in accordance with International Concrete Repair Institute (ICRI) recommendations to achieve a CSP 3 profile. Thoroughly vacuum clean floors upon completion of blast operation. Substrate to be approved in writing by manufacturer prior to application of coating.

.1 Submit written report to *Consultant* following procedures for manufacturer’s field review in accordance with Section 01 45 00.

.9 Cover or mask surfaces adjacent to those receiving coating to protect work of others and property from damage and soil.

3.3 Installation

.1 General:

.1 Apply coatings with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen and texture, all within limitations of materials and areas concerned.

.2 Match colours and textures of approved samples.

.3 Make clean true junctions with no visible overlap between adjoining applications of coatings.

.4 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.

.5 Place cloths and other disposable coating materials, that are a fire hazard, in closed metal containers and remove from building every night.

.6 Verify that spark-proof electrical equipment is used in area where inflammable materials are being applied.

.7 Erect barriers to prevent the entry and presence of personnel not performing work of this section during application of coatings, and for 48 hours following completion of application.

.8 Apply coating system in compliance with coating manufacturer's directions to produce a pinhole free surface that also provides a positive slope to drains in flooring system.

.9 Apply coatings in continuous manner, starting and stopping in straight lines centre at doorways or other building lines; haphazard installation continuation lines will not be permitted.

.2 Application; flooring system:

.1 Terminate flooring in straight lines at centreline of door in openings where adjacent floor finish or colour is dissimilar.

.2 Trowelled or broadcast installation shall not show telegraphing of substrate or trowel or toolmarks.

.3 Trowelled or broadcast installation shall be homogenous free of substrate lines, pockets, bumps and unevenness greater than 1.5 mm (1/16”) in 300 mm (12"), not including texture.

.4 Prime coat: mix components and apply primer over prepared substrate at manufacturer's recommended spreading rate, with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

.5 Body coat: mix components and trowel apply body coats over tacky primer at spreading rates as recommended by manufacturer. Broadcast aggregate into wet body coat. Build up flooring system as required to provide positive slope to drains.

.6 Clean surface prior to application of finish coat for approval by *Consultant*.

.7 Finish coats: Squeegee apply finish coats over tacky primer at spreading rates as recommended by manufacturer.

.8 Provide zinc termination strips, of appropriate thickness, at cove base and where flooring system meets different flooring types.

.9 Install beads at top of bases, and apply coating to wall with cove formed at junction with floor.

.10 Apply cove base to a height of 100 mm (4") on vertical surfaces unless shown otherwise. Apply a continuous and even radius at floor transition. Apply base screed at termination of base. Fill gaps between base screed and wall with underlayment material.

.3 Use saw cut and chip method at termination locations unless otherwise indicated.

.4 Joints: Where substrate is interrupted by expansion or control joints, provide joint in coating system to comply with details indicated, of if not indicated, as recommended by coating system manufacturer. Fill joints with specified compounds.

.5 Match approved samples in sheen, colour and texture.

3.4 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00 and as follows:

.1 Field tests and inspections:

.1 Moisture and alkalinity:

.1 Test for moisture vapour transmission in accordance with ASTM F1869-16a in accordance with manufacturer's written installation requirements. Maximum percentage of moisture acceptable is 1.8 kg/93 m^2 (4 lb/1000 ft^2) in a 24 hour period, unless otherwise specified by manufacturer's printed literature.

.2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-17.

.3 For each test type: Perform 3 tests for flooring applications less than 186 m^2 (2000 square feet) in area, and 1 test per additional 93 m^2 (1000 square feet).

.2 Coating thickness:

.1 Verify to Tooke thickness gauge, and in the presence of *Consultant* and manufacturer's representative, that thicknesses of completed coatings meet specified requirements.

.2 Perform cut through/coring tests where selected by *Consultant* 1 per 93 m^2 (1000 ft^2) in finished areas to determine thicknesses and finishes of epoxy coatings.

.3 *Contractor* shall repair areas as a result of inspection and testing work.

.3 Manufacturer's field review to be in accordance with Section 01 45 00.

3.5 Adjusting and Cleaning

.1 Touch up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

.2 Remove promptly as work progresses spilled or spattered coating materials from surfaces of work performed under other sections. Clean surfaces on completion of work. Do not mar surfaces while removing.

.3 Leave storage and mixing areas in same condition as equivalent spaces in project. Clean flooring just prior to final acceptance using materials and procedures recommended by flooring manufacturer.

.4 Final cleaning is specified in section 01 78 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Painting of interior paintable surfaces (PT-1, PT-2, PT-3, PT-4, and PT-5).

.2 Paintable and non-paintable surfaces:

.1 Paint and finish paintable surfaces included in the *Work*, except where excluded by the *Contract Documents*.

.2 The following surfaces are considered non-paintable, except as otherwise indicated or scheduled:

.1 Material and equipment furnished prime and finish painted.

.2 Internal surfaces of steel tanks and stacks.

.3 Sprayed fire-resistive materials.

.4 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered or mill finished aluminum, Monel metal.

.5 Metallic and mastic insulation finishes.

.6 Abrasive material finishes on floors, stair treads, stair nosing and landings.

.7 Insulated electric cables.

.8 Machined parts of machinery and equipment.

.9 Concealed surfaces.

.10 Manufactured finish materials.

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 20.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer’s *Product* data sheets and list of *Products* proposed for use in the work of this section as identified in ‘Approved Product List’ section of the MPI Architectural Painting Specification Manual. Correlate *Products* to Schedule furnished by *Consultant*.

.3 Samples:

.1 Samples for initial paint colour and finish selection:

.1 Submit manufacturer's colour charts showing full range of colours available, including light and deep dark tones, for each type of finish material indicated for colour selection by *Consultant*.

.2 *Consultant* shall have complete freedom in choice of colours in compiling colour schedule and will not necessarily select colours from standard colour charts of manufacturer of *Products* specified.

.3 Submit 3 drawdowns of each selected colour for review by *Consultant* and resubmit to *Consultant* as required to obtain approval. Drawdown to be of specified colour, sheen, and paint formula for applicable surface.

.2 Samples for verification:

.1 Submit 3 samples on 200 mm x 305 mm (8"x 12") material of same type as that on which coating is to be applied, for *Consultant*'s approval, at least 30 days before materials are required.

.2 Identify each sample as to *Project*, finish, formula, colour name, number, gloss name and number, date and name of *Contractor* and painting *Subcontractor*.

.3 Resubmit as required until colours and gloss value are approved.

.4 MPI Manual:

.1 Submit 1 copy of MPI Manual – latest edition, and maintain at site office for reference.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer’s operation and maintenance instructions for inclusion in the operation and maintenance manuals.

.3 Maintenance materials:

.1 Provide 2 sealed containers, each of 4 litres (1 gallon) capacity of each paint product in each colour used in the *Work* for *Owner's* maintenance use. Containers shall be new, clearly labelled with manufacturer's name, type of paint, colour and colour number. Store at *Place of the Work* where directed by *Owner*.

1.5 Quality Assurance

.1 Qualifications

.1 Manufacturers:

.1 Paint manufacturers and *Products* used shall be as listed under the Approved Product List section of the MPI Painting Manual.

.2 Installers / applicators / erectors:

.1 Applicators: Shall have 5 years’, minimum, proven satisfactory painting experience of projects of similar size and class subject to *Consultant’s* approval.

.2 Only qualified journeymen who have a “Tradesman Qualification Certificate of Proficiency” shall be engaged in painting work. Apprentices shall work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.2 Mock-ups:

.1 Provide mock-ups of each paint system for indicated surfaces of each colour and finish selected to verify preliminary paint selections made under Sample submittals.

.2 Mock-ups shall be located to areas as directed by *Consultant* under lighting conditions matching final area lighting, for acceptance by *Consultant*.

.3 Mock-ups shall demonstrate aesthetic effects of paint colour and sheen and shall set quality standards for material and execution of the *Work*. Final approval of colour and finish selections shall be based on mock-ups. If colour selections are not approved, apply additional mock-ups of additional colours selected by *Consultant* at no added cost to the *Owner*.

.4 Do not proceed with work, including ordering of paint *Products*, until mock-ups of each paint colour and finish and paint system for indicated surfaces have been reviewed and accepted by *Consultant*.

.5 Upon completion and approval, mock-ups shall serve as a standard for the balance of the work of this section. Subsequent work carried out and not in the *Consultant's* opinion equal to standard shall be repainted without charge.

1.6 Delivery, Storage, and Handling

.1 Deliver painting materials in sealed, original labelled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

.2 Store paint *Products* and materials in original labelled containers in secure (lockable), dry, heated and well ventilated single designated area meeting minimum requirements of both paint manufacturer and authorities having jurisdiction, and at a minimum ambient temperature of 7°C (45°F).

.3 Protect floor and wall surfaces of storage area. Protect floors with sheets or clean plywood or metal pans where mixing is being carried out.

1.7 Field Conditions

.1 Ambient conditions:

.1 Comply with environmental requirements of MPI Manual.

.2 Perform no painting work when ambient air and substrate temperatures are below 10°C (50°F) for both interior and exterior work, unless suitable weatherproof covering and sufficient heating and ventilation facilities are in place in accordance with MPI Manual.

.3 Perform no painting work when relative humidity is above 85% or when dew point is less than 3°C (5°F) variance between air/surface temperature.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Except where more stringent requirements are specified, the following reference standard shall govern the work of this section:

.1 Master Painters Institute (MPI) Architectural Painting Specification Manual (MPI Manual), including Identifiers, Evaluation, Systems, Preparation and Approved Product List, latest edition, and referenced herein as the MPI Manual, as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.2 Materials, preparation and workmanship shall conform to requirements of latest edition of Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.3 Painting systems:

.1 Shall remain free from failure due to causes including: material failure; surface preparation less than that specified; and paint film thickness less than that specified, or when not specified, less than that coverage recommended by manufacturer.

.2 Presence of any of following shall constitute failure: visible corrosion; film peeling, blistering, checking, scaling, embrittling or general film disintegration; and poor adhesion as determined by tape "peel-off" test procedures.

2.2 Materials

.1 Products listed in MPI Manual shall be used in the *Work*, unless specified otherwise.

.2 Paint and materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and the like) shall be in accordance with the MPI Manual “Approved Product” listing and shall be from a single manufacturer for each system used.

.3 Other paint materials, such as linseed oil, shellac, and the like, shall be highest quality *Products* of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials as required.

.4 Paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.

.5 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by building code requirements and/or authorities having jurisdiction.

2.3 Equipment

.1 Painting and coating equipment in accordance with written requirements of MPI Manual.

2.4 Mixing and Tinting

.1 Unless otherwise specified, paints shall be ready-mixed. Re-mix prior to application to ensure colour and gloss uniformity.

.2 Paste, powder or catalyzed paint mixes shall be mixed in accordance with manufacturer’s written requirements.

.3 Perform colour tinting operations prior to delivery of paint to *Place of the Work*.

.4 Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

2.5 Colours and Gloss Levels

.1 Paint colours and gloss levels shall be as selected by the *Consultant*. Locations as indicated or scheduled.

.2 Colour and gloss schedule: Refer to Material Legend.

.3 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 maximum
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 minimum
G5	Semi-gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

PART 3 - EXECUTION

3.1 Examination

.1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.

.2 Check moisture content and alkalinity of surfaces to be painted in accordance with paragraph above titled Field Conditions.

.3 Inspect surfaces to be coated for gouges, marks, nibs, and other defects and properly prepare patching, filling, smoothing or other surface preparation necessary to ensure satisfactory finish.

.4 Report in writing any condition adversely affecting work of this section.

.5 Proceed with work only when surfaces and conditions are satisfactory. Remove dust, grease, rust, scale and extraneous matter, tool and machine marks and insects from surfaces which could be detrimental to a satisfactory and acceptable finish.

3.2 Preparation

.1 Comply with manufacturer's written requirements and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

.2 Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

.1 After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

.3 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, mildew, grease, and incompatible paints, encapsulants, and other deleterious materials.

.4 Paint surfaces when moisture content or alkalinity of surfaces to be painted comply with paragraph 3.5 Field Quality Control / Standard of Acceptance.

.5 Shop-primed steel substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

.6 ZF75 and ZF120 galvannealled-metal substrates: Remove grease and oil residue from galvannealled sheet metal by methods to produce clean surfaces that promote adhesion of subsequently applied paints.

.7 Aluminum substrates: Remove loose surface oxidation.

.8 Existing painted substrates:

.1 Clean substrates as indicated above.

.2 Sound existing paint surfaces and remove paint surfaces that are not sound, loose or are otherwise stained, cracked, wrinkled, peeling, or defective.

.3 Dull hard or glossy surfaces by sanding or other abrasive methods prior to finishing.

.4 Apply tie-coat primer product that compatible with substrate as recommended by paint coatings manufacturer.

.5 Follow with paint finish coats as specified for like substrate materials specified herein.

3.3 Installation

.1 Do not paint unless substrates are acceptable and/or until Field Conditions (heating, ventilation, lighting and completion of work of other sections) are acceptable for applications of *Products*.

.2 Apply primer, paint or stain in accordance with MPI Manual Premium Grade finish requirements.

.3 Apply paint and coatings within an appropriate time frame after cleaning when Field Conditions encourage flash-rusting, rusting, contamination or manufacturer’s paint specifications require earlier applications.

.4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer’s recommendations.

.5 Tint each coat of paint progressively lighter to enable confirmation of number of coats.

.6 Unless otherwise approved by *Consultant*, apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.

.7 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000 mm (39").

.8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.

.9 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer's directions.

.10 Paint finish shall continue through behind wall-mounted items (i.e. chalk and tack boards) and exposed/ visible in complete work including interiors of cupboards and closets, tops of doors, trim, and the like, whether in sight line or not, including behind surface mounted fixtures and heating units.

.11 *Consultant* shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to *Owner*.

.12 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces in terms of colour, texture and sheen, unless otherwise indicated.

3.4 Field Quality Control / Standard of Acceptance

.1 Conduct quality control in accordance with Section 01 40 00.

.1 Field tests and inspections:

.1 Paint and Coating Quality Assurance Inspections:

.1 Field quality control shall be in accordance with Section 01 40 00.

.2 Moisture and alkalinity testing:

.1 Check moisture content of surfaces to be painted using properly calibrated electronic moisture meter approved by paint manufacturer, and *Consultant*, or other approved method. Maximum moisture contents shall be in accordance with manufacturer's recommendations and as follows:

.1 Concrete and concrete masonry (clay and concrete brick/block): Maximum 12%.

.2 Gypsum board and plaster: Maximum 12%.

.3 Wood: Maximum 15%.

.2 Conduct moisture tests on concrete floors using cover patch test method.

.3 Test concrete, masonry and plaster surfaces for alkalinity.

.3 Painted interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the *Consultant*:

.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.

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

.3 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.4 Damage due to application on moist surfaces or caused by inadequate protection from weather.

.5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

.4 Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces to the *Consultant*:

.1 Visible defects are evident on vertical and horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").

.2 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.

.3 When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.

.5 Painted surfaces rejected by the *Consultant* shall be made good at the expense of the *Subcontractor*. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

.6 Painting *Subcontractor* shall obtain from *Contractor* written confirmation of specific surface preparation procedures and primers used for fabricated steel items from the fabricator/*Supplier* to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

3.5 Adjusting and Cleaning

.1 Promptly as work proceeds and on completion of *Work*, remove paint where spilled, splashed or spattered during the progress of the *Work*. Keep the premises free from unnecessary accumulation of tools, equipment, surplus materials and debris; at the conclusion of the work leave the premises clean.

3.6 Interior Paint Systems

.1 System references listed are based on MPI Manual and are Premium Grade, unless otherwise indicated:

.1 Primed ferrous metal; touch-up and finish coats required under this section:

.1 Ferrous metal fabrications: Prepared and primed in accordance with Section 05 50 00.

.2 INT 5.1D Alkyd dry fall finish.

.3 INT 5.1R High performance architectural latex; gloss level G5.

.2 Galvanized metal: (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc.)

.1 INT 5.3F Alkyd dry fall finish (for use on low contact / low traffic areas only).

.2 INT 5.3M High performance architectural latex; gloss level G5.

.3 Plaster and gypsum board: (gypsum wallboard, drywall and textured finishes)

.1 INT 9.2B High performance architectural latex finish:

.1 Gloss level:

.1 Walls, except as otherwise indicated: G3.

.2 Ceilings, except as otherwise indicated: G1.

.2 Use high-hide primer sealer type at glass mat finished gypsum board.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Magnetic glass marker boards (MWB-1).

.2 Related trim, adhesives, and fastenings.

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Show proposed system of anchorage and materials being supplied on shop drawings submitted for review.

.2 Show dimensional layouts, hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.

.4 Samples:

.1 Submit 305 mm x 305 mm (12" x 12") samples of each *Product* specified, diagonally cut to show cross section through assembly, complete with accessories and trim.

1.3 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 Quality Assurance

.1 Qualifications:

.1 Installers / applicators / erectors:

.1 Erection of materials to be carried out by competent workers supervised by a foreperson with at least 10 years' experience in this specialized field and approved in writing by manufacturer for installation of their *Product*.

1.5 Delivery, Storage, and Handling

.1 Package *Products* to prevent distortion in shipment and handling. Label and protect finish surfaces by sturdy wrappings.

PART 2 - PRODUCTS

2.1 Design/Performance Requirements

.1 Trademarks and labels:

.1 No trademarks or labels will be accepted on exposed finished work.

2.2 Glass Marker Boards (MWB-1)

.1 Back-coated, tempered glass marker boards with permanently adhered magnetic steel backing and a smooth, non-staining surface intended for use with dry-erase markers; framing and mounting as indicated on drawings.

.2 Acceptable manufacturers:

.1 Clarus.

.3 Sizes: as indicated on drawings.

.4 Glass type:

.1 Tempered low iron glass; ANSI Z97.1 and CPSC 16 CFR 1201, ASTM C1036-16 and ASTM C1048 for Quality Q3, Kind FT.

.2 Glass edges shall be polished with slight arrises.

.3 Manufacturer’s standard back paint coating applied to #2 (back) side uniformly.

.4 Adhered steel backing. Steel: Magnetic, 0.85 mm thick, commercial quality ASTM A653/653M steel with Z275 (G90) designation zinc coating.

.5 Glass thickness: 6.4 mm (1/4").

.5 Mounting method:

.1 Concealed mounting: concealed z-bar hanger furnished with 3M ‘Dual Lock’ fasteners to hold bottom of board firmly in place.

2.3 Accessories

.1 Rail Support System:

.1 Rails: Horizontal, wall-mounted, extruded-aluminum rails designed to receive hanger clip and to support visual display boards.

.1 .Finish: Clear anodized / Baked enamel / Powder coat.

.2 .Colour and Gloss: As selected by *Consultant* from manufacturer's full range.

.2 Hanger Clips: Extruded aluminum with finish to match rails; designed to support independent visual display boards by engaging support rail and top trim of board.

.2 Frames and Trim: ASTM B221/221M, minimum 1.5 mm thick, extruded aluminum in Alloy 6063-T5; slim size and standard shape unless otherwise indicated on drawings.

.1 Trim: Manufacturer's standard, field-applied, snap-on trim with no visible screws or exposed joints.

.3 Marker Tray: ASTM B221/221M, minimum 1.5 mm thick extruded aluminum in Alloy 6063-T5, box type one-piece tray with punched holes for holding markers vertically.

.1 Acceptable *Product*:

.1 'Box Tray' by Clarus in Satin Silver colour.

.4 Markers and Eraser: Manufacturer's standard low odour dry erase markers in a set of four colours; provide one set of markers and one dry eraser for each visual display unit installed.

.5 Magnets: 25 mm square magnets; provide one set of 3 for each magnetic visual display unit installed.

.1 Acceptable *Product*:

.1 'Square Magnets' by Clarus in Satin Silver colour.

PART 3 - EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's written installation requirements.

.2 Locate seams as directed by the Consultant.

3.2 Installation - Trim Components

.1 Install in accordance with manufacturer's written installation requirements.

3.3 Installation Tolerances

.1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:

.1 Within 1.5 mm (1/16") of plumb and level, and flush with adjacent panels.

.2 Within 25 mm (1") variation from indicated position.

3.4 Adjusting and Cleaning

.1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.

.2 Do not remove protective coatings until final cleaning, or earlier if directed by *Consultant*.

.3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at *Place of the Work* only if approved.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Folding privacy screen.

1.2 Administrative Requirements

.1 Coordination:

.1 Supply manufacturer's handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with *Products* specified in this section in order that they function as intended.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Samples:

.1 Submit 3 samples of each finish specified.

.4 Shop drawings:

.1 Clearly indicate, materials, finishes, fabrication details, dimensions, thicknesses, plans, elevations, hardware, and installation details.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Delivery, Storage, and Handling

.1 Package or crate, and brace products to prevent damage during shipment and handling. Label packages and crates, and protect finish surfaces from environmental conditions where required.

.2 Deliver products to location at the *Place of the Work* designated by *Contractor*.

PART 2 - PRODUCTS

2.1 General

.1 Incorporate reinforcing, fastenings and anchorage required for building in of *Products*.

2.2 Pole Mounted Folding Privacy Screen

.1 Acceptable *Product*:

.1 Silentia Folding Screen, wall mounted.

.2 Size: as indicated on drawings.

.3 Provide panels complete with casters, supports, spaces, and hardware.

.4 Number of panels: as indication on drawings.

.5 Finish: to later selection by the *Consultant* from manufacturer's full range.

PART 3 - EXECUTION

3.1 Preparation

.1 Ensure that rough-in dimensions and blocking or back-up has been provided to comply with product manufacturer's written requirements.

3.2 Installation

.1 Submit manufacturer's information and templates required for installation of work of this section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with *Products* specified in this section in order that they function as intended.

.2 Install work to meet manufacturers' recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.

.3 Include reinforcing, anchorage and mounting devices required for the installation of each *Product*.

.4 Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.

.5 Fabricate *Products* with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that specified items will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

.6 Supply handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with *Products* specified in this section.

.7 Back paint components where contact is made with building finishes to prevent electrolysis.

3.3 Adjusting and Cleaning

.1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation.

.2 Do not remove protective coatings until final cleaning in accordance with Section 01 78 00, or earlier if directed by *Consultant*.

.3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at *Place of the Work* only if approved.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Washroom accessories.

.2 Coat hooks.

.3 Coordination and installation of washroom accessories as supplied by *Owner*.

1.2 Administrative Requirements

.1 Coordination:

.1 Supply manufacturer's handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with *Products* specified in this section in order that they function as intended.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Samples:

.1 Submit 3 samples of each finish specified.

.4 Shop drawings:

.1 Include plans, elevations, hardware, and installation details.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Delivery, Storage, and Handling

.1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

.2 Deliver products to location at the *Place of the Work* designated by *Contractor*.

PART 2 - PRODUCTS

2.1 Accessories

.1 Incorporate reinforcing, fastenings and anchorage required for building-in of *Products*.

.2 Washroom accessories; locations as indicated or scheduled.

.1 Toilet paper tissue dispenser (TPTD):

.1 Acceptable Product:

.1 Tork Bath Tissue Jumbo Roll Dispenser, Twin.

.2 Soap dispenser (SD):

.1 Acceptable Product:

.1 Deb ProLine 1 Litre Host Dispenser.

.3 Hand dryers, electric (HD):

.1 Acceptable products:

.1 Dyson Airblade V.

.4 Grab bars (GB-1):

.1 Acceptable Product:

.1 Bobrick ‘B-6898.99’.

.5 Grab bars (GB-2):

.1 Acceptable Product:

.1 Bobrick ‘B-6806x24’.

.6 Shelf (SHF):

.1 Size: 127 mm wide x 405 mm long.

.2 Acceptable Products:

.1 Bobrick ‘B-295 x 16’.

.2 ASI Group Canada #0694.

.7 Stainless steel backrest:

.1 Acceptable Product:

.1 Frost Products Ltd ‘Model 1028'.

.3 Washroom accessories supplied by *Owner*; locations as indicated or scheduled:

.1 Napkin disposal (ND).

.2 Paper towel dispenser/disposal (PTD).

2.2 Coat Hooks

.1 Surface mount, one-piece, No. 4 satin finished stainless steel, square profile clothes hook with concealed mounting.

.2 Acceptable *Product*:

.1 Model No. 8425 by ASI Group Watrous.

2.3 Fabrication

.1 Fabricate *Products* with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that washroom accessories will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

PART 3 - EXECUTION

3.1 Preparation

.1 Verify that rough-in dimensions and blocking or back-up has been provided to comply with product manufacturer's written requirements.

3.2 Installation of Washroom Accessories

.1 Supply manufacturer's handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with *Products* specified in this section in order that they function as intended.

.2 Comply with product manufacturers written requirements.

.3 Install and secure fixtures rigidly in place using expansion shields in solid masonry or concrete, toggle bolts in hollow masonry or sheet metal screws at metal studs.

.4 Insulate surfaces to prevent electrolytic action due to contact with dissimilar metals, or concrete or masonry as applicable. Use bituminous paint or other approved means.

.5 Install on built-in concealed solid backing materials. Grab bar installation shall be able to withstand 250 kg downward force.

.6 Verify locations and mounting heights with *Consultant* before roughing-in.

3.3 Barrier Free Installation Heights

.1 Install accessories to permit operable parts and controls to be accessed in accordance with authorities having jurisdiction.

3.4 Installation Tolerances

.1 Install accessories plumb, level, straight, tight and secured, centred between joints on masonry and tile walls to the following maximum tolerances:

.1 Plumb and level: 3 mm (1/8").

.2 Variation from indicated position: 3 mm (1/8").

3.5 Adjusting and Cleaning

.1 Verify under work of this section that installed *Products* function properly, and adjust them accordingly to ensure satisfactory operation. Test mechanisms, hinges, locks, and latches and adjust and lubricate to ensure washroom accessories are in perfect working order.

.2 Do not remove protective coatings until final cleaning, or earlier if directed by *Consultant*.

.3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at *Place of the Work* only if approved.

END OF SECTION

PART 1- GENERAL

1.1 Summary

.1 Section includes:

.1 Pass through boxes to provide means of transferring products or equipment from a background environment into a controlled environment.

1.2 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Shop drawings:

.1 Prepare drawings of general arrangement of pass-through hatches and loads to be carried by building structure.

.2 Obtain review of drawings by *Consultant* and authorities having jurisdiction, before proceeding with installation.

1.3 Quality Assurance

.1 Qualifications:

.1 Manufacturers:

.1 Work of this section shall be fabricated by one manufacturer, by skilled workers in shop of a company specializing in work specified.

.2 Manufacturer shall have minimum of 5 years of continued experience, having successfully completed other laboratory projects of similar or greater magnitude.

1.4 Closeout Submittals

.1 Submit closeout submittals in accordance with Section 01 78 00.

.2 Operation and maintenance data:

.1 Submit manufacturer’s operation and maintenance instructions for inclusion in the operation and maintenance manuals.

.2 Parts, maintenance, operating and servicing manuals: Upon completion, submit maintenance, servicing and operating catalogues individually bound.

1.5 Delivery, Storage, and Handling

.1 Prevent damage to components during handling.

PART 2 - PRODUCTS

2.1 Specimen Pass-Through Box Construction

.1 Envelope and liner:

.1 Shall be constructed of 304 stainless steel, No. 4 brushed finish, of internal space dimensions as indicated.

.2 Mounting flange shall be on clean side end face for flush mounting to wall.

.2 Doors:

.1 Door Hinges: Full-height stainless piano type hinges.

.2 Door shall provide an air tight assembly.

.3 Doors shall be equipped with a mechanical interlock latch system fabricated of Type 304 stainless steel, where steel is to be welded, bright polished finish. Interlock shall allow only one door to be open at any time.

2.2 Pass-through boxes:

.1 Inside dimensions: 305 mm (12”) x 305 mm (12”) x 457 mm (18”) W x D x H.

.2 Acceptable Product: as indicated on drawings.

PART 3 - EXECUTION

3.1 Installation

.1 Install pass-through hatches in existing openings at the *Place of the Work* in accordance with manufacturer’s recommendations and requirements of authorities having jurisdiction.

.2 Secure to face of finished walls and partitions.

.3 Install components to effect a secure, neat and complete installation.

3.2 Field Quality Control

.1 Conduct quality control in accordance with Section 01 40 00.

3.3 Closeout Activities

.1 Demonstration

.1 At a time to be identified by *Consultant*, the *Subcontractor* responsible for the work of this section shall instruct *Owner's* personnel in proper use, operations, and daily maintenance of pass-through hatches. *Subcontractor* shall train *Owner's* personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

.2 Instruction shall also include advice on the maintenance of each item of equipment.

END OF SECTION

MECHANICAL GENERAL REQUIREMENTS
20 01 01

1 GENERAL

1.1 General Contract Documents

.1 Comply with General Conditions of Contract, Supplementary Conditions and Division 1 - General Requirements.

1.2 Work Included

.1 Work to be done under Divisions 20, 21, 22, 23 and 25 to include furnishing of labour, materials and equipment required for installation, testing and putting into proper operation complete mechanical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

1.3 Document Organization

.1 Applicable Divisions for Mechanical Work:

.1 Division 20 - Common Work for Mechanical

.2 Division 21 - Fire Protection

.3 Division 22 - Plumbing and Drainage

.4 Division 23 - Heating, Ventilation and Air Conditioning (HVAC)

.5 Division 25 - Building Automation System

.2 For clarity, any reference in the Contract Documents to Division 20 includes Divisions 21, 22, 23 and 25.

.3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.

.4 Contractor is responsible for completion of work whether or not portions are sublet.

1.4 Division 20, as it applies to Divisions 21, 22, 23 and 25

.1 Articles that are of a general nature, applicable to each Section of these Divisions.

.2 Articles specifying materials, equipment, installation techniques and workmanship that are applicable to more than one Section of these Divisions.

.3 Articles that are to be read in context with and form part of relevant Sections of these Divisions.

1.5 Definitions

.1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in this Specification, mean that material or item referred to as "indicated", "shown", "listed" or "noted" on Drawings or in Specification.

.2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar

words or phrases used in this Specification, mean that material or item referred to is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by", Consultant.

.3 Instructions using any form of word "provide" involves Contractor in furnishing labour, materials and services to supply and install referenced item.

1.6 Language

.1 The specification is written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where list follows a semi-colon (;) the punctuation is for clarity. Where a list follows a colon (:) the punctuation is to be read as a short-hand form of the verb “to be” or “to have” as context requires.

.2 It is not intended to debate with the Contractor the reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.7 Examination

.1 Examine any existing buildings, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the work.

.2 No allowance will be made for any expense incurred through failure to make these examinations of the site and the documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

.3 Examine work of other Divisions before commencing this work, and report any defect or interference.

1.8 Design Services

.1 Provide design services for elements of the Work where specified in other sections of Division 20, sealed by a professional engineer licensed in the applicable jurisdiction.

1.9 Standard of Material and Equipment

.1 Provide materials and equipment in accordance with Division 01.

.2 Materials and equipment:

.1 new and of uniform pattern throughout work,

.2 of Canadian manufacture where obtainable,

.3 standard products of approved manufacture.

.4 labeled or listed as required by Code and/or Inspection Authorities,

.5 registered in accordance with the requirements of TSSA Boilers and Pressure Vessels Safety Division Guidelines for the Registration of Non-nuclear Fittings in the Province of Ontario,

.6 in compliance with Standards and Regulations with respect

to; (a) chemical and physical properties of materials,
(b) design,
(c) performance characteristics, and
(d) methods of construction and installation.

.7 identical units of equipment to be of same manufacture.

.8 identical component parts of same manufacture in similar units of equipment, but various component parts of each unit need not be from one manufacturer.

.3 Materials and equipment are described to establish standards of construction and workmanship.

.1 Where manufacturers or manufacturers' products are identified in lists with the phrase "Standard of Acceptance", these are manufacturers and/or products which meet required standards with regard to performance, quality of material and workmanship.

.2 Manufacturers and or products used are to be chosen from these lists.

.4 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.

.5 Materials and equipment not satisfying these selection criteria will be condemned.

.6 Remove condemned materials from job site and provide properly selected and approved materials.

1.10 Substitutions

.1 The use of a substitute article or material which the manufacturer represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions:

.1 a substitution will not be considered for reasons of meeting the construction schedule unless the contractor can demonstrate to the satisfaction of the Consultant they made all reasonable efforts to procure the specified product or material in a timely fashion,

.2 the manufacturer must advise the Consultant of this intention to use an alternative article or material before doing so,

.3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer and they shall supply all information necessary as required by the Consultant at no additional costs to the contract,

.4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and their decision to be final,

.5 where use of an alternative material involves redesign or changes to other parts of the work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,

.6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed. Such request to be made in ample time to permit appropriate review without delaying the work, taking into consideration that such a substitution request may be rejected and require providing the product or material as originally specified,

.7 Whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,

.8 The costs of all testing required to prove equality of the material proposed to be borne by the manufacturer.

2 SUBMITTALS

2.1 Shop Drawings and Product Data Sheets

.1 Submit shop drawings, manufacturers and product data and samples in accordance with Section 01 33 05.

.1 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and imperial measures may be included.

.2 Submitted shop drawings.

.2 Include shop drawing cover sheet form prepared for this project, for each shop drawing, or, include the same information on the general or trade contractor's submittal cover sheet:

.1 Information required on each submission:

(a) Client/Architect name
(b) Project Name
(c) Quasar project number
(d) Date
(e) Contractor name
(f) Contractor reference no.
(g) Manufacturer name
(h) Product type
(i) Specification section number
(j) Contractor trade: mechanical, electrical, elevators, or general trades
(k) If a re-submission, include the Quasar number from the previous submission.

.3 Submit shop drawings in PDF format;

.1 If submitted in hardcopy format, submit in 8.5 x 11 or 11 x 17 size, black and white originals of graphic quality suitable for photocopying. Allow one additional week for processing of shop drawings submitted in hardcopy format.

.2 for each item of equipment.

.4 Manufacturer's letter sized printed data sheets, as black and white originals of graphic quality suitable for photocopying, are acceptable in place of shop drawings for standard production items.

.5 Submit with manufacturers data sheets, typed schedules listing manufacturer's and supplier's name and catalogue model number for;

(a) valves,
(b) traps,
(c) expansion joints,
(d) pipe hangers

.6 For plumbing fixtures, submit fixture cuts with catalogue numbers for fixtures to be used on job. Identify and arrange fixture cuts in same sequence as specification fixture list.

.7 Shop drawings and product data to show;

(a) dimensioned outlines of equipment
(b) dimensioned details showing service connection points.
(c) elevations illustrating locations of visible equipment such as gauges, pilot lights, breakers and their trip settings, windows, meters, access doors.
(d) description of operation.
(e) single line diagrams.

(f) general routing of bus ducts and connecting services.
(g) mounting and fixing arrangements.
(h) operating and maintenance clearances, and
(i) access door swing spaces.

.8 Shop drawings and product data to be accompanied by;

(a) detailed drawings of bases, supports and anchor bolts,
(b) sound power data, where applicable, and
(c) performance curve for each piece of equipment marked with point of operation.

.9 Shop drawing and data sheet submission is taken as certification;

.1 that units are from Manufacturer's current production and

.2 in compliance with applicable Codes, Standards, and Regulations.

.10 Do not submit drawings showing internal construction details, component assemblies or interior piping and wiring diagrams. These may be necessary to understand correct functioning of equipment and should be submitted with operating and maintenance data.

.11 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.

.12 Keep one copy of each reviewed shop drawing and product data sheet on site available for reference purposes.

.13 Where equipment is delivered without reviewed shop drawing available on site, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawing has been submitted and reviewed.

2.2 Field, Fabrication, or Installation Drawings

.1 Contractor field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal only will be returned identifying the submitted drawings have not been reviewed.

.2 Maintain a copy on site of such drawings for reference by the Consultant.

.3 Provide a copy of such drawings to the Consultant for general information purpose only, upon request.

3 REFERENCE CODES STANDARDS AND REGULATIONS

3.1 Codes, Standards and Regulations

.1 Latest current versions in force at time of Tender.

.2 Where relevant documents applicable to this work exist, follow these criterion, recommendations, and requirements as minimum standards.

.3 In event of conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring application of most demanding requirements.

3.2 Confined Spaces

.1 Unless otherwise proscribed by the Constructor's / Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to:

.1 horizontal and vertical service spaces, shafts, and tunnels,

.2 inside of equipment which permits entry of the head and/or whole body, and

.3 ceiling spaces which are identified as containing a hazardous substance.

3.3 Permits, Tests and Certificates

.1 Arrange and pay for permits, tests, and Certificates of Inspection required by Authorities having jurisdiction.

.2 Submit applications requiring Owner's signature before commencing work.

.3 Obtain and submit Inspection Certificates.

.4 Certificates to be renewed as to remain in force for guarantee period.

.5 Co-ordinate and perform testing required by Authorities having jurisdiction in accordance with Clause TESTING in this Section

4 EQUIPMENT

4.1 Manufacturers Nameplates

.1 Metal nameplate with raised or recessed lettering, mounted on each piece of equipment.

.2 On insulated equipment, mechanically fasten plates on metal stand-off bracket arranged to clear insulation and mount Underwriters Laboratories and/or CSA registration plates on same stand-off brackets.

.3 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating of motors, and approval listings.

4.2 Factory Applied Finish Painting

.1 Apply prime and final paint coats to equipment and materials where specifically detailed in Sections of these Divisions.

.2 Apply prime and final paint coats factory to pumps, air moving units, un-insulated pressure vessels and bare metal equipment items in boiler, mechanical and fan rooms.

.3 Use heat resistant paint where conditions require.

.4 Protect factory finished equipment during construction, and clean at completion of work.

4.3 Factory Applied Prime Painting

.1 Have prime paint factory applied to other equipment fabricated from iron or steel including access doors, registers, grilles, diffusers, dampers, metal radiation enclosures and fire hose cabinets.

4.4 Field Painting

.1 After equipment has been installed and piping and insulation is completed, clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted.

.2 In "occupied" areas of building touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Finishes, Division 9.

.3 In "un-occupied" areas of the building such as mechanical equipment rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses:

.1 paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% Alkyd base enamel in an approved colour; and

.2 paint exposed iron or steel work with one coat of chrome oxide phenolic base primer and one coat of 100% Alkyd base enamel in an approved colour.

4.5 Provision for Future

.1 Where space is indicated as reserved for future equipment or for future extension to building, leave such space clear and install piping, raceways and equipment so that connections can be made to future apparatus or building.

.2 Identify provisions and service terminations for future on Record Drawings.

4.6 Maintenance of Bearings

.1 "Turn over" rotating equipment at least once a month from delivery to site until start-up.

.2 "Run-in" sleeve type bearings in accordance with manufacturer's written recommendation. After "run-in", drain, flush out and refill with new charge of oil or grease.

.3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation during building construction.

4.7 Pre-purchased Equipment Damage and Ownership

.1 At time of receipt of pre-purchased or pre-tendered equipment at job site by the installing mechanical contractor, the manufacturer/Distributor/supplier technical representative to be present to inspect the equipment prior to unloading and report any damage to the Consultant. The technical representative to also witness the unloading and advise the contractor on the appropriate method for handling the equipment in order to avoid damage during the unloading, moving and setting in place phase of the equipment.

.2 In the event the equipment has been found to be damaged before unloading it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.

.3 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the installing contractor is responsible for repairs and/or replacement to the satisfaction of the Owner.

5 OFFICE, STORAGE AND TOOLS

5.1 Office and Storage

.1 Provide temporary office and lunchroom facilities, workshop, and tools and material storage space.

Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.

.2 Assume responsibility for security of these facilities and provide heat, light and telephone and Internet service.

.3 Owners cafeteria is off limits.

5.2 Appliances and Tools

.1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, required to carry out work.

6 COORDINATION

6.1 General

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as “double line”, they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

.2 Lay out and coordinate Work to avoid conflict with work under other Divisions.

.3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.4 When equipment provided under other Sections connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

.5 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.6 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.7 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.8 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.

.9 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the work as an operating installation.

6.2 Field, Fabrication, and Installation Drawings

.1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades.

.1 Drawing scale: minimum 1:50 (1/4"=1'-0")

.2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.3 Layout equipment and services to provide access for repair and maintenance.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' review".

6.3 Cutting and Remedial Work

.1 For details of cutting and patching and Division of Work refer to Division 1.

.2 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing trades and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade whose work is involved to do such cutting and patching. Pay for any resulting costs. Layout such work for approval by the Structural Engineer before undertaking same.

.3 Neatly cut or frill holes required in existing construction to accommodate cable, raceways, bus duct or cabletray.

.4 Division 20 contractor to be responsible for arranging and paying for all cutting and patching as required for own work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant's approval of location and methods in writing. Employ original installer or expert in the finishing of material required to perform cutting or patching for weather exposed or moisture resistant elements or sight exposed surfaces.

.5 Layout cutting of structural elements, such as floor slabs, walls, columns or beams and obtain approval before starting work. Conduct a ground penetrating radar scan for reinforcing rods with structural or grade slabs and review with the Structural Engineer. Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling. GPR scan is to penetrate the complete depth of the slab.

.6 Arrange and pay for supplemental ground penetrating radar (GPR) examination to locate concrete reinforcement, conduits and other embedments. Submit GPR results and obtain approval before starting work.

6.4 Anchors and Inserts

.1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

7 PROTECTION OF WORK AND PROPERTY

7.1 General

.1 Protect this work and work of other trades from damage.

.2 Cover floors with tarpaulins and provide plywood and other temporary protection.

.3 Assume responsibility for repairing damage to floor and wall surfaces resulting from failure to provide adequate protection.

.4 Protect equipment, pipe and duct openings from dirt, dust and other foreign materials.

8 WORK IN EXISTING BUILDING

8.1 General

.1 During the tender period, the Contractor shall perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of As Built conditions to determine scope of renovation or demolition work required prior to submitting tender.

.2 Work includes changes to existing building and changes at junction of old and new construction.

.3 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services required for proper installation of new work, including as required for temporary removal and re-installation to suit new installation work.

.4 Remove existing plumbing fixtures, lighting fixtures, piping, ductwork, wiring, and equipment to suit new construction. Cut back and cap drain, vent and water outlets, conduits and electrical outlets, not being used.

.5 Contractor to include for sprinkler drain down(s) and refill(s) as required to complete the scope of work. Provide a fire watch for the duration of sprinkler shut-down. Restore sprinkler system to active conditions when the fire watch is not provided. Coordinate scheduling with building management/Owner.

.6 Plumbing fixtures, piping, ductwork, conduit and wiring shown to be removed and not shown relocated, to become property of Contractor and to be taken from site.

.7 On completion of relocations, confirm relocated equipment are in proper working order.

.8 Where Owner wishes to take over renovated areas ahead of project completion date and these areas are to be fed from new distribution systems, make temporary connections to existing services in these areas. Reconnect to permanent services, at later date, when new distribution systems are available.

8.2 Continuity of Services

.1 Make connections to existing systems at approved times. Obtain written approval recording times when connections can be made. Arrange work so that physical access to existing buildings is not unduly interrupted.

.2 Be responsible for and make good any damages caused to existing systems when making connections.

.3 Keep existing buildings in operation with minimum length of shutdown periods. Include overtime work to tie-in piping or wiring at night or on weekends.

9 TEMPORARY HEATING

9.1 During Construction

.1 Temporary heating required while building is under construction will be provided under Division 1.

.2 Permanent heating system may be used for temporary heating, when this equipment is installed in its permanent location and building is closed in and Contractor under Division 1 provides staff for operation and maintenance whenever permanent heating system is being used for temporary heating.

.3 Hot water boilers may not be used unless heating units, radiation, pumps and piping are complete and approved chemical water treatment is in operation.

.4 Permanent heating equipment used for temporary heating to be thoroughly cleaned and put in first class approved operating condition and appearance at completion of job.

10 FINAL CLEANING AND ADJUSTMENTS

10.1 General

.1 Conduct final cleaning in accordance with Section 01 74 23 and as specified herein.

.2 Thoroughly clean exterior surface of exposed piping, and vacuum external surfaces of exposed ducts and interior surfaces of air handling units. Clean strainers in piping systems and install clean filters in air handling systems.

.3 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.

.4 Calibrate components and controls and check function and sequencing of systems under operating conditions.

.5 Supply lubricating oils and packing for proper operation of equipment and systems until work has been accepted.

11 RECORD DRAWINGS

11.1 Record drawings

.1 Provide record drawings in accordance with Division 01 and as specified herein.

.2 A set of design drawings in AutoCad on CD or DVD ROM will be provided by the Consultant. Make sets of white prints for each phase of Work, and as Work progresses and changes occur mark white prints in coloured inks to show revisions. Dimension locations of drains, pipes, ductwork, conduit, manholes, foundations and similar buried items within the building, with respect to building column centres. Mark level with respect to an elevation which will be provided.

.3 Survey information from excavation and backfill of site services to be held on site, after approval, and to be similarly transferred to white prints.

.4 Retain these drawings and make available to Consultant for periodic review.

.5 At 50%, 75% and 90% project completion, scan marked-up drawings to Adobe .pdf format and submit copy to the Consultant, or to the project on-line document service if one is used.

11.2 As-built drawings

.1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad (CAD) files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.

.1 Drawings are to remain set to and follow Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.

.2 The Consultant's CAD files may not reflect all or any construction changes.

.2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. “Bubble” these revisions, and place these annotations on a separate and easily identified drawing layer.

.3 Show on mechanical as-built drawings final location of piping, ductwork, switches, starters, Motor Control Centres, thermostats, and equipment.

.4 Show on site services as-built drawings survey information provided by Ontario Land Surveyor (OLS) monitoring services installation.

.5 Identify each drawing in lower right hand corner in letters at least 12 mm (½ in) high as follows "AS- BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include signature and stamp of OLS surveyor attached to note.

.6 Submit one (1) set of white prints of the draft as-built Cad files for Consultant’s review.

.7 Once “AS BUILT DRAWINGS” white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to “As Built” condition to Consultants on CD or DVD Rom.

.8 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

12 OPERATING AND MAINTENANCE INSTRUCTIONS

12.1 Operating and Maintenance Manuals

.1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.

.1 Organize material in volumes generally grouped by Trade Section; Site services, Plumbing, Fire Protection, Heating and Cooling Plant and Distribution, Air Handling, and Controls and Instrumentation.

.2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear Project Name, Project Number, Date, Trade Section, and List of Contents.

.2 In addition, provide Adobe PDF files for each document, produced from original direct-to-digital file creations.

.1 Organize documents into separate PDF files for each Trade Section identified above, and apply Adobe Bookmarks to create Table of Contents.

.3 Operating data to include;

.1 control schematics for each system,

.2 description of each system and associated control elements,

.3 control operating sequences at various load conditions, reset schedules and anticipated

seasonal variances,

.4 operating instructions for each system and each component,

.5 description of actions to be taken in event of equipment failure,

.6 valves schedule and flow diagram,

.7 service piping identification charts.

.4 Maintenance data to include;

.1 manufacturer's literature covering, servicing, maintenance, operating and trouble-shooting instructions for each item of equipment,

.2 fault locating guide,

.3 manufacturer's parts list,

.4 reviewed shop drawings,

.5 equipment manufacturer's performance sheets,

.6 equipment performance verification test results,

.7 voltage and ampere rating for each item of electrical equipment,

.8 spare parts list and an itemized cost,

.9 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

.5 Approval procedure

.1 Submit one set of first draft of Operating and Maintenance Manuals for approval.

.2 Make corrections and resubmit as directed.

.3 Review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation.

.4 Hand-over two copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.

12.2 Operating and Maintenance Instructions

.1 Provide instructions to Owners operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections in these Divisions. Include classroom instruction and hands-on instruction, delivered by competent instructors.

.2 Submit an outline of the training program for review, adjustment and approval by the Owner.

.3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, utilizing the services of the manufacturers' representative as required.

.4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each training session, separated by approximately one week each. Develop the proposed training plan and obtain approval from the Owner before commencing training.

.5 Complete the training as close to Substantial Performance as possible, so that the operations

staff are prepared to operate the systems after Substantial Performance is certified.

.6 Organize each training sessions as follows:

.1 Fire Protection - Division 21

.2 Plumbing – Division 22

.3 HVAC – Division 23

.4 Building Management System – Division 25

.7 Keep record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

.8 For each training session, include the following topics:

.1 General purpose of system (design intent),

.2 Use of O&M manuals,

.3 Review of control drawings and schematics,

.4 Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming troubleshooting, and alarms,

.5 Interaction with other systems,

.6 Adjustments and optimizing methods for energy conservation,

.7 Health and safety issues,

.8 Special maintenance and replacement sources,

.9 Occupancy interaction issues, and

.10 System response to different operating conditions.

.9 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and electronic format, in accordance with article on Operating and Maintenance Manuals.

.10 Sessions may be videotaped by the Owner as an aid to ongoing training of Owners staff.

13 START-UP AND TESTING

13.1 Care, Operation and Start-up

.1 Arrange and pay for services of manufacturer's factory service technician to supervise start-up of installation, check, adjust, balance and calibrate components.

.2 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 with every aspect of the operation, care and maintenance thereof.

13.2 TESTING - General

.1 Methods to comply with following references:

(a) The Ontario Building Code
(b) Ontario Installation Code for Oil-burning Equipment
(c) CSA B149.1 Natural Gas and Propane Installation Code

.2 Conduct tests, during progress of Work and at its completion to show equipment and systems

meet contract. Submit details of test methods in writing and obtain approval before commencing work.

.3 Supply test equipment, apparatus, gauges, meters and data recorders, together with skilled personnel to perform tests and log results.

.4 Submit written notice 24 hours in advance of each test series, setting out the time, place and nature of the tests, the Inspection Authority and personnel witnessing tests.

.5 Conduct tests before application of external insulation and before any portion of pipes, ducts or equipment is concealed.

.6 Do not subject expansion joints, flexible pipe connections, meters, control valves, convertors, and fixtures, to test pressures, greater than stated working pressure of equipment. Isolate or remove equipment or devices during tests when prescribed test pressure is greater than working pressure of any piece of equipment or device.

.7 Should section of pipe or duct fail under test, replace faulty fittings or duct with new fittings, pipe or duct, repair and retest. Do not repair screwed joints by caulking nor welded joints by peening. Repeat tests until results are satisfactory.

.8 Where it is necessary to test portions of duct or piping system before system is complete, overlap successive tests so that no joint or section of duct or pipe is missed in testing.

.9 Upon completion of work and testing of same, submit logs to demonstrate that tests have been carried out satisfactorily. Repeat any tests if requested.

13.3 Testing - Potable Water Piping

.1 Test potable water systems with water or air as required by The Ontario Building Code, Part 7.

.2 For water service pipes 100 mm (4") and larger, disinfect the pipe with chlorine from the street valve to the first shut-off valve inside the building. Provide testing laboratory certificate confirming water contaminates are below the threshold values in O.Reg. 248/06.

13.4 Testing - Other Piping

.1 Hydraulically test other water piping systems at 1½ times system design pressure (relief valve setting) or 1000 kPa (150 psi), whichever is greater, for 24 hours. Pressure must remain essentially constant throughout test period without pumping. Make allowance for correction of pressure readings for variations in ambient temperature between start and finish of test. Hammer test welded joints during hydrostatic test.

.2 Test natural gas system to CSA B149.1

.3 Test fuel oil systems to CSA B139

.4 Test drainage, waste and vent piping for tightness and grade as required by The Ontario Building Code, Part 7.

.5 Test special service piping as detailed.

.6 Test high pressure steam piping and compressed air piping in accordance with requirements of local and Provincial Authorities.

13.5 Testing - Ventilation

.1 Test ductwork in accordance with procedures detailed.

13.6 Testing - Electrical

.1 Make tests of equipment and wiring.

.2 Tests to include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load and examination of each piece of equipment for correct operation.

.3 Test electrical work to standards and function of Specification and applicable Codes.

.4 Replace defective equipment and wiring with new material.

.5 Connect single phase loads to minimize unbalance of supply phases.

14 TEMPORARY AND TRIAL USAGE

14.1 General

.1 Temporary and trial usage by Owner of any mechanical or electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance is not to be construed as evidence of acceptance by Owner.

.2 Owner to have privilege of such temporary and trial usage, as soon as that said work is claimed to be completed and in accordance with Contract Documents, for such reasonable length of time as is sufficient for making complete and thorough test of same.

.3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

.4 Defects in workmanship and materials identified during temporary and trial usage are to be rectified under guarantee.

15 SPECIAL TOOLS AND SPARE PARTS

15.1 General

.1 Furnish spare parts as follows

- .1 One set of packing for each pump gland.
- .2 One casing joint gasket for each size pump.
- .3 One head gasket for each heat exchanger.
- .4 One glass for each gauge glass.
- .5 One set of V-belts for each drive.
- .6 One filter cartridge or set of filter media for each filter or filter bank installed.

16 CONSULTANT REVIEWS

16.1 General

.1 Consultant's attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority have jurisdiction.

16.2 Site Reviews

.1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Any such reported items, or lack thereof, shall not be relied on in any way as part of the Contractors quality assurance program nor relieve the Contractor in the performance of the Work.

.2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless otherwise shown.

16.3 Milestone Reviews

.1 Specific milestone reviews may be conducted at key stages by the Consultant, including;

.1 before backfilling of buried drainage,

.2 before closing of shafts,

.3 before closing of ceilings,

.4 before closing of walls,

.5 equipment demonstration,

.6 Substantial Performance deficiency review,

.7 Total Performance deficiency review.

.2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements in the construction schedule.

.3 Notify the Consultant in writing seven (7) calendar days in advance of work to be concealed to arrange a site review prior to the Work being concealed where required by the Consultant. Any noted deficiencies are to be corrected before being concealed. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

16.4 Substantial Performance Review

.1 At the time of applying for project Substantial Performance, submit to Consultant a comprehensive list of items to be completed or corrected.

16.5 Final Review

.1 At project completion submit written request for final review of mechanical and electrical systems.

.1 Refer to section 20 08 19 Project Close-Out.

.2 Include with the request a written certification that:

.1 reported deficiencies have been completed,

.2 systems have been balanced and tested and are ready for operation,

.3 completed maintenance and operating data have been submitted and approved,

.4 tags are in place and equipment identification is completed,

.5 cleaning is finished in every respect,

.6 all mechanical equipment surfaces have been touched up with matching paint, or re-finished

as required,

.7 spare parts and replacement parts specified have been provided and receipt acknowledged,

.8 As-built and Record drawings are completed and approved,

.9 Owner's operating personnel have been instructed in operation and maintenance of systems,

.10 fire protection verification is 100% completed and Verification Certificates have been submitted and accepted.

17 CORRECTION AFTER COMPLETION

17.1 General

.1 At completion, submit written guarantee undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.

.2 Guarantee to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.

.3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

END OF SECTION

QUALIFICATIONS AND AUTHORITIES - ONTARIO
20 01 02

1 GENERAL

1.1 Scope

.1 Qualification requirements for tradesmen in the province of Ontario.

.2 Registration and inspection of systems.

2 QUALIFICATIONS

2.1 Trades Qualification and Apprenticeship Act

.1 Tradesmen to hold certification of applicable trades:

- .1 Construction Millwright, O.Reg. 1048
- .2 Electrician, O.Reg. 1051
- .3 Plumber, O.Reg. 1073
- .4 Refrigeration and air-conditioning mechanic, O.Reg. 75/05
- .5 Sheet metal worker, O.Reg. 1077
- .6 Sprinkler and fire protection installer, O.Reg. 1078
- .7 Steamfitter, O.Reg. 1079

2.2 Technical Standards and Safety Authority Act 2000

.1 Manufacturers and installers of regulated pressure piping parts and systems regulated to hold certificates of authorization under Boilers and Pressure Vessels O.Reg. 220/01, for;

- .1 pressure piping systems, CSA B51 Boiler, Pressure Vessel and Pressure Piping Code
- .2 refrigeration piping systems, CSA B52 Mechanical Refrigeration Code

.2 Installers to hold certificates of authorization made under Fuel Industry Certificates O.Reg. 215/01 for;

- .1 Gaseous Fuels, O.Reg. 212/01
- .2 Propane Storage and Handling, O.Reg. 211/01
- .3 Fuel Oil, O.Reg. 213/01
- .4 Compressed Natural Gas, O.Reg. 214/01

3 AUTHOURITIES, REGISTRATION AND INSPECTION

3.1 Ontario Building Code

.1 Application for Building Permit including plumbing and HVAC has been made by the Owner. Arrange and coordinate for municipal inspections as required under the Ontario Building Code.

3.2 Technical Standards and Safety Authority

.1 Arrange, provide documentation, and pay for registration and inspection of the following systems:

- .1 Boiler, pressure vessel and pressure piping

.2 Arrange, provide documentation, and pay for variance approvals and field inspections of the following systems:

.1 Fuel safety, gas and/or oil, where Variance approval is required.

3.3 Electrical Safety Authority

.1 Provide, arrange and pay for permits and inspection of electrical systems in accordance with the Ontario Electrical Safety Code.

END OF SECTION

MECHANICAL COORDINATION AND INSTALLATION DESIGN SERVICES
20 01 03

1 GENERAL

1.1 Scope

.1 Provide detailed coordination, fabrication, and installation design drawings for the services provided under Division 20. Integrate the coordination drawings provided under Division 26 into the design drawings provided under Division 20.

.2 Provide the services of an experienced mechanical and electrical coordination supervisor to manage these contractors' design services. The supervisor is responsible for leading a multi-trade coordination effort including but not limited to: detailed inspection of existing conditions, layout and finalize routing of services, setting sleeves for structural openings and sequencing of service installation.

1.2 Document Ownership

.1 Ownership and copyright of Contractors coordination, fabrication, and installation design drawings remains with the Contractor producing these documents, subject to the requirements of the project agreement. In the absence of any requirements in the project agreement, the Contractor will provide the Owner with a royalty-free, transferrable, and irrevocable license to copy and use the materials for the purpose of operating and maintaining the building and building systems.

1.3 Consultant Drawings

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, bus duct, etc, and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

1.4 Design Commentary

.1 The following design commentary is provided to assist the contractor in developing an appreciation for the potential complexities and level of risk which may impact the preparation of a bid price for the Work. This commentary does not limit the scope of work nor does it address all potential risk factors associated with the Work.

.1 Coordination of work with existing services;

.2 Constricted space within ceiling plenum for installation of equipment and services;

.3 Coordination of work in occupied spaces.

1.5 Requests for Information

.1 Requests for Information (RFI's or similar type of document) concerning coordination are to be submitted with sketch drawings indicating proposed solution for review by the Consultant. RFI's submitted without such proposals will be returned for re-submission.

1.6 Itemized Price

.1 Include costs associated with this Section as an Itemized Price in the Bid documents.

2 INTERFERENCE CO-ORDINATION DRAWINGS

2.1 General

.1 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.2 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.3 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.4 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.5 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.

.6 Include incidental material and equipment not specifically shown but which is needed to complete the work as an operating installation.

2.2 Interference Coordination Drawings

.1 Prepare interference coordination drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades. Drawings shall be prepared by a specialist firm experienced in CAD mechanical and electrical interference drawing production. Interference drawings are to include coordination with all mechanical and electrical services.

.2 Mechanical contractor is to consult and co-operate with electrical contractor to identify electrical services which are to be incorporated into interference drawings. Contractor shall perform site survey work to document all existing mechanical and electrical services that are to remain and are to be included in the interference drawings.

.3 Conduct weekly meetings to discuss and resolve interference issues discovered during interference drawing production.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' general review"

.5 Drawing scale to be minimum 1:50 (1/4"=1'-0").

.6 Produce coordination drawings, preferably in 3D AutoCad MEP or Revit MEP format, and keep a set of drawings on site for Consultant's general review.

.7 Obtain architectural and consultant's drawing files for background information, pending completion and return of any electronic file waiver forms.

2.3 Coordination with Other Trades

.1 Lay out and coordinate Work to avoid conflict with work under other sections of this Division and other Divisions.

.2 When equipment provided under other Sections or Divisions connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

2.4 Interconnecting Control and Power Wiring

.1 Provide wiring block diagrams and detailed termination drawings for controls wiring connections to equipment and instrumentation, for both Building Automation System control and hard-wired interlock wiring. Provide wiring terminal numbers specific for each equipment connection.

2.5 Fire Alarm and Building Automation System

.1 Provide a wiring coordination interface drawing for termination of fire alarm annunciation circuits to Building Automation System I/O equipment and/or motor starters, adjustable frequency drives, dampers, and motorized fire dampers.

.2 Drawings to include wiring terminal numbers and description label for FAS annunciation zone.

2.6 Owners Equipment and Relocated Equipment

.1 The service provisions shown for Owner's supplied equipment and/or relocated equipment is based on the best available information at the time of design. Examine the actual service requirements for this equipment and make adjustments as necessary to connection sizes of service drops to suit. A change (increase or decrease) in one trade size for piping, tubing, electrical conductors and conduit, and a change of up to 25% in duct cross-sectional area will be provided at no change to the construction cost.

.2 Where actual service requirements (except as described above for size) are different between the Consultant's drawings and Owner's equipment requirements, submit proposal for new or deleted services or capacities to the Consultant for review.

3 FABRICATION AND INSTALLATION DRAWINGS

.1 On an as-needed basis, prepare fabrication, spooling, and/or installation drawings based on the completed interference coordination drawings. CAD drawing system is in accordance with Contractor's company standards.

.2 Drawing scale: same as the interference coordination drawings or at larger scale as needed.

.3 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.4 Layout equipment and services to provide access for repair and maintenance.

END OF SECTION

BASIC MATERIALS AND METHODS
20 05 01

1 GENERAL

1.1 Scope

.1 Articles that are of a general nature, applicable to each Section of Division 20.

2 ACCESS DOORS

.1 Provide access doors to be installed at locations where equipment requiring inspection, service, maintenance or adjustment is "built-in" to work of other trades.

.2 Access is required at;

- .1 expansion joints,
- .2 dampers,
- .3 fire dampers,
- .4 air valves,
- .5 air terminal units,
- .6 isolation and control valves ,
- .7 pressure reducing valves,
- .8 heating or cooling coils,
- .9 control wiring junction boxes.

.3 Submit shop drawings showing access door size, type and location.

.4 Construction:

- .1 constructed of steel, prime coated,.
- .2 flush mounted with 180° opening door, round safety corners, concealed hinges, plaster lock and anchor straps
- .3 all access doors to be 600 mm x 600 mm (24 in x 24 in),
- .4 constructed of stainless steel in areas finished with tile or marble surfaces
- .5 constructed of stainless steel with neoprene gasketed door in damp and high humidity areas
- .6 generally fitted with screwdriver operated latches, except in areas subject to security risks (Public Corridors, Psychiatric Patient Areas, Public Washrooms). In these areas doors to be fitted with keyed cylinder locks with similar keys.

Standard of Acceptance

- Baird - ABCO
- Stelpro - Type 700
- Williams Brothers - GP
- LeHage
- Acudor Acorn
- Mifab

.5 Installation:

- .1 Supply access doors and make arrangements and pay for installation by Division in whose work they occur.

.2 Size and locate access doors in applied tile, block or in glazed or unglazed structural tile to suit joint patterns.

.3 Access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive tile insert.

.4 Access doors are not required in removable ceilings. Provide coloured marking devices after completion of ceilings, at four corners of each panel below point requiring access. Colour code markers to show service or device above.

.5 At time of instruction of owners operating staff, hand-over and obtain signed receipt for 4 sets of each type of key used to lock access doors in secure areas.

3 DIELECTRIC COUPLINGS

.1 Provide dielectric isolation between pipes of dissimilar metals with suitable couplings, insulating dielectric unions, insulating flanges, or insulating gaskets between flanges.

.1 Place dielectric isolation between steel piping and bronze or brass valves.

.2 Do not use bronze or brass valves as dielectric fittings.

.2 Insulating unions for pipe sizes NPS 2 and under

Standard of Acceptance
- Epco - Dielectric
- Watts

.3 Insulating flanges for pipe or tube from NPS 2 to NPS 4

Standard of Acceptance
- Watts No. 3100 or 3200

.4 Insulating gaskets for flanges NPS 5 and over:

.1 compatible with pressure and temperature service,

.2 flange bolts run in insulating sleeves with insulating washers under nuts.

4 DRAIN VALVES

.1 Provide drain points for piping systems with drain valves at low points and at section isolating valves.

.2 Drain valves: minimum NPS straight pattern bronze with hose end male thread, cap and chain.

5 V-BELT DRIVES

.1 Provide V-belt drive for each motor driven device which is not direct connected. Keep overhung loads on prime mover shafts within manufacturer's design guidelines.

.2 Sheaves for motors to 7.5 kW (10 hp) with not more than two belts:

.1 cast iron or steel secured to shafts with removable keys.

.2 adjustable pitch on motor, fixed pitch on driven device, giving plus or minus 10% speed range,

.3 selected to meet specified operating condition at mid position in pitch adjustment.

.3 Sheaves for motors over 7.5 kW (10 hp) or drives with three or more belts

.1 cast iron or steel with split tapered bushing and keyway.

.2 fixed pitch.

.4 Belts:

.1 matched sets of 'b' section, selected for service factor of 2.0 based on installed motor horsepower.

.2 capable of carrying load with one belt broken.

.5 Motor slide rails:

.1 adjustment plates for centre line alignment

.2 belt tension adjusting screws.

.6 Installation

.1 Tension belts to manufacturer's recommendations before start-up and after first 100 hr of operation using calibrated belt tensioning gauge.

.2 Provide replacement pulleys and belts during start-up and balancing to suit field operating conditions.

6 DRIVE AND COUPLING GUARDS

.1 Provide guards to protect belt drives, flywheels, rotating couplings on equipment and fan inlet and outlets.

.2 Guards:

.1 removable for servicing,

.2 arranged to permit lubrication with guards in place.

.3 Guards for belt drives:

.1 expanded metal screen welded to steel bar stock or angle frame,

.2 minimum 1.2 mm (18 ga) thick galvanized sheet metal tops and bottoms,

.3 40 mm (1½") diameter holes at both shaft centres for insertion of tachometer.

.4 Flexible coupling and flywheel guards:

.1 Removable "U" shaped, minimum 1.6 mm (16 ga) thick galvanized mild steel or expanded metal mesh on substantial welded angle iron or round barstock frame.

.5 Guards on unprotected fan inlets and outlets:

.1 Minimum 20 mm (¾ in) galvanized wire mesh or expanded metal screen with net free area of guard not less than 80% of fan opening.

.6 Installation

.1 Belt guards to accommodate movement of motors for belt tension adjustment.

.2 Where equipment is installed on resiliently mounted base frame or pad, attach belt guard to this base

.3 Belt guards and fan inlet guards may be omitted where fan and motor is installed in plenum less than 1.4 m (4 ft) high and disconnect for fan motor is mounted adjacent to and outside access door to plenum.

.4 Fan inlet guards may be omitted where fan is fitted with inlet guide vanes.

7 SLEEVES

7.1 General

.1 Sleeve pipes, ducts and conduits passing through masonry walls, concrete floors, and fire rated gypsum board ceilings and partitions.

.2 Maintain fire rating integrity where pipes and ducts pass through fire rated walls, floors and partitions.

7.2 Floor and Wall Sleeves

.1 Sleeves in fire separations:

.1 sized to suit fire stopping methods employed for bare pipes, conduits, insulated pipes, and bare and insulated ducts without fire dampers, and

.2 sized to suit conditions of approval given in manufacturers installation instructions for fire and smoke dampers.

.2 Sleeves in other construction:

.1 sized to clear insulated pipes and ducts by 13 mm (½ in) all round, and

.2 sized to clear conduits, bare pipes, and bare ducts by 6 mm (¼ in) all round.

.3 Sleeves for pipes, conduits and ducts smaller than 0.4 m^2 (4 sq ft) through solid walls and floors:

.1 Schedule 40 steel pipe or 1 mm (20 ga) (minimum) sheet metal, lapped and spot welded.

.2 Sleeves for pipes, conduits and ducts smaller than 0.4 m^2 (4 sq ft) through gypsum board partitions:

(a) 1 mm (20 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one and.

.4 Sleeves for ducts 0.4 m^2 (4 sq ft) and larger through walls and floors:

.1 1.6 mm (16 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one end.

7.3 Waterproof sleeves

.1 Applications:

.1 where pipes and ducts pass through floors in areas subject to water, in mechanical rooms, in kitchens, in washing areas and in slabs over electric and telephone rooms.

.2 Waterproof sleeves for pipes and conduits:

.1 Schedule 40 pipe, with 75 mm (3 in) wide annular fin continuously welded at midpoint, hot dip galvanized after fabrication.

.3 Waterproof sleeves for ducts less than 0.4 m^2 (4 sq ft):

.1 1 mm (20 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint.

.4 Waterproof sleeves for ducts 0.4 m^2 (4 sq ft) and larger and openings with multiple ducts:

.1 1.6 mm (16 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint, or,

.2 form opening with wood (removed after concrete is set) and trim opening with welded steel angle frame 75 mm (3 in) high , bolted to slab and caulked, or,

.3 trim opening with 75 mm x 75 mm (3 in x 3 in) continuous concrete curb doweled to slab.

.5 Modifications for existing construction:

.1 annular fins and flanges attached to sleeve at point equivalent to surrounding floor level or curb.

7.4 Installation

.1 Place and secure sleeves in concrete form work.

.2 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.

.3 Regular sleeves;

.1 terminate flush with surfaces of concrete and masonry walls.

.4 Waterproof sleeves in new construction;

.1 extend 75 mm (3 in) above finished floor.

.2 with flange embedded within concrete floor.

.5 Sleeves in existing concrete and masonry walls and floors;

.1 installed in neatly cut or drilled holes in existing construction,

.2 cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with procedure set out in Article "Cutting and Patching" below.

.3 terminate sleeves flush with surfaces of concrete and masonry walls,

.4 extend waterproof sleeves 75 mm (3 in) above finished floor with flange, countersunk, and bolted down flush into floor surface,

.5 fill opening between sleeve and wall or floor with 2 hour fire rated fire-stopping sealant with water barrier.

.6 Fill future-use sleeves with weak concrete, gypsum plaster or similar material.

.7 Coat exposed exterior surfaces of un-galvanized ferrous sleeves with heavy application of zinc rich paint

.8 At fire separations and smoke separations, pack and seal void between sleeve and pipe, duct without fire damper, conduit, or insulation in accordance with Article "Fire Stopping and Smoke Seals" in this Section.

.9 At other locations, pack void between sleeve and pipe, conduit, duct or insulation for full depth of sleeve, with mineral wool and seal with silicone-free caulking compound.

.10 Install fire dampers in accordance with conditions of approval given in manufacturer's instructions.

8 FIRE STOPPING AND SMOKE SEALS

8.1 General

.1 Provide fire stopping and smoke seals where ducts, pipes or conduits penetrate fire separations. Materials to be supplied, worker training to be arranged, and installation to be supervised, by a specialist firm with an established reputation in this field.

.2 Fire stop materials to be impervious to water when installed in a horizontal separation, including waterproof service sleeves.

8.2 Products

.1 Materials to form ULC listed or cUL listed/classified assemblies.

Standard of Acceptance
- 3M
- Nelson Firestop Products
- Hilti Firestop Systems
- Eastern Wire + Conduit (Royal Quickstop)

.2 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

8.3 Installation

.1 Seal space between penetrating service and sleeve or opening in slab with firestop and smoke sealing system in strict accordance with terms and conditions of original ULC or cUL listing and manufacturers recommended procedures.

.2 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.

.3 Select firestopping system to allow insulation and vapour barrier to pass un-broken through assembly.

.4 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of materials

.5 Do not apply fire stopping materials to fire or smoke dampers.

9 WALL AND FLOOR PLATES

.1 Fit pipes passing through walls, floors and ceilings in finished areas with escutcheon, wall or floor plates.

.2 Plates:

.1 at floor; chrome plated two piece split type with hinge.

.2 at walls and ceilings; similar to floor plate but with set screw to fasten plate to pipe.

9.2 Installation

.1 Plates:

.1 sized to cover sleeves

.2 secured tight against finished surfaces, and

.3 fitted to cover sleeve extensions where sleeves extend above finished floor.

10 LINK SEALS

.1 Fit each pipe passing through floor slab in contact with ground or basement walls below grade with link seal between sleeve and bare pipe.

.2 Submit manufacturer's literature and schedule showing location, service, inside diameter of wall opening, sleeve length and pipe outside diameter.

.3 Link seal:

.1 Manufactured from modular synthetic rubber links with stainless steel hardware.

.2 Loosely assembled with bolts to form continuous rubber belt around pipe, with pressure plate under each bolt head and nut.

.3 Constructed to provide electrical insulation between pipe and sleeve.

Standard of Acceptance
- Power Plant Supply - "Thunderline Linkseal"
- Advance Products & Systems – "Innerlynx"

.4 Installation

.1 Determine inside diameter of each wall opening or sleeve before ordering seal.

.2 Position seal in sleeve around pipe and tighten bolts to expand rubber links until watertight seal is obtained.

11 PLATFORMS, LADDERS, COVERS, PIPE SUPPORTS, EQUIPMENT SUPPORTS, AND BASES

11.1 Supports for mechanical and electrical work

.1 Fabricate platforms, gratings, ladders, piping and equipment supplementary supporting steel, and trench and pit covers, from steel and provided by this Division.

.2 Concrete housekeeping bases for mechanical and electrical equipment which are in direct contact with floor slab, to be provided by this Division.

.3 Concrete bases for equipment supported on vibration isolation materials (inertia pads), to be provided by this Division.

.4 Work to be done by firms specializing in these fields.

.5 Submit shop drawings for steel and concrete work, prepared by licensed Professional Engineers.

11.2 Applicable codes and standards;

.1 Ministry of Labour

.1 Engineering Data Sheets

.2 Health and Safety Guidelines

.3 Industrial Alert Bulletins

.2 Regulations made under the Occupational Health and Safety Act;

.1 Regulations for Industrial Establishments

.2 Regulations for Health Care and Residential Facilities

.3 The Ontario Building Code

.4 American Society for Testing and Materials (ASTM)

.1 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.3 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.5 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.40, Anti-corrosive Structural Steel Alkyd Primer.

.2 CAN/CGSB-1.108, Bituminous Solvent Type Paint.

.3 CAN/CGSB-1.181, Ready-Mixed, Organic Zinc-Rich Coating.

.6 Canadian Standards Association (CSA)

.1 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel.

.2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-S16.1, Limit States Design of Steel Structures.

.4 CSA W59, Welded Steel Construction (Metal Arc Welding).

11.3 Supplementary supports and support brackets:

.1 Fabricated from structural grade steel with anchor bolts and fastenings.

.2 Designed in consultation with building structural consultant to transfer live loads and dead loads to building structural elements,

.3 Constructed as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

11.4 Trench covers, and pit covers:

.1 Fabricated with:

.1 75 mm x 75 mm x 9.5 mm (3 in x 3 in x ⅜ in) welded angle frame with anchor bars,

.2 25 mm x 9.5 mm (1 in x ⅜ in) trim bar to fit concrete pit, and with matching chequer plate cover,

.3 hot dip galvanized after fabrication

11.5 Concrete bases for housekeeping pads:

.1 Constructed using plywood form work and 20 Mpa (3000 lb) concrete,

.2 Doweled to concrete floor slab with not less than 13 mm (½ in) diameter steel rods.

.3 Plan dimensions:

.1 75 mm (3 in) larger all around than base of apparatus for non-seismic applications,

.2 200 mm (8 in) larger all around than base of apparatus for seismically restrained equipment, and

.3 finished to make smooth, neat surfaces with corners chamfered 25 mm (1 in).

.4 Height conforming to following table;

Equipment	Floor Type	Vibration Isolation	Thickness of Housekeeping Pad mm (in)
Stationary, not motorized	All	All	100 (4)
Motorized, up to 7.5kW (10 HP)	All	---	150 (6) (max. for fans)
Motorized, 11 to 19kW (15 to 25 HP)	Slab on Grade	No	250 (10)
	Slab on Grade	Yes	150 (6)
	Suspended Slab	Yes	150 (6)
Motorized, 22kW (30 HP) and over	Slab on Grade	No	300 (12)
	Slab on Grade	Yes	150 (6)
	Suspended Slab	Yes	150 (6)

11.6 Installation - General

.1 Locate supporting steel to permit removal of parts for service or repair, and to allow clear access to valves, fittings, and equipment,

.2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, vibration mountings and snubbers.

.3 Set equipment base plates on housekeeping pads on minimum 13 mm (½ in) epoxy grout and fill hollow portion of base with concrete.

.4 Install anchor bolts, vibration mountings and snubbers between equipment and housekeeping pad, or inertia pad and housekeeping pad.

.5 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.6 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.7 Make field connections with bolts to CAN/CSA-S16.1, or weld.

.8 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.

.9 Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.10 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich paint.

11.7 Installation - Equipment subject to thermal expansion

.1 Applicable to hot equipment which is not supported on spring vibration isolators, including but not limited to:

.1 boilers, hot water heaters,

.2 heat exchangers,

.3 expansion tanks,

.4 dearators and condensate tanks,

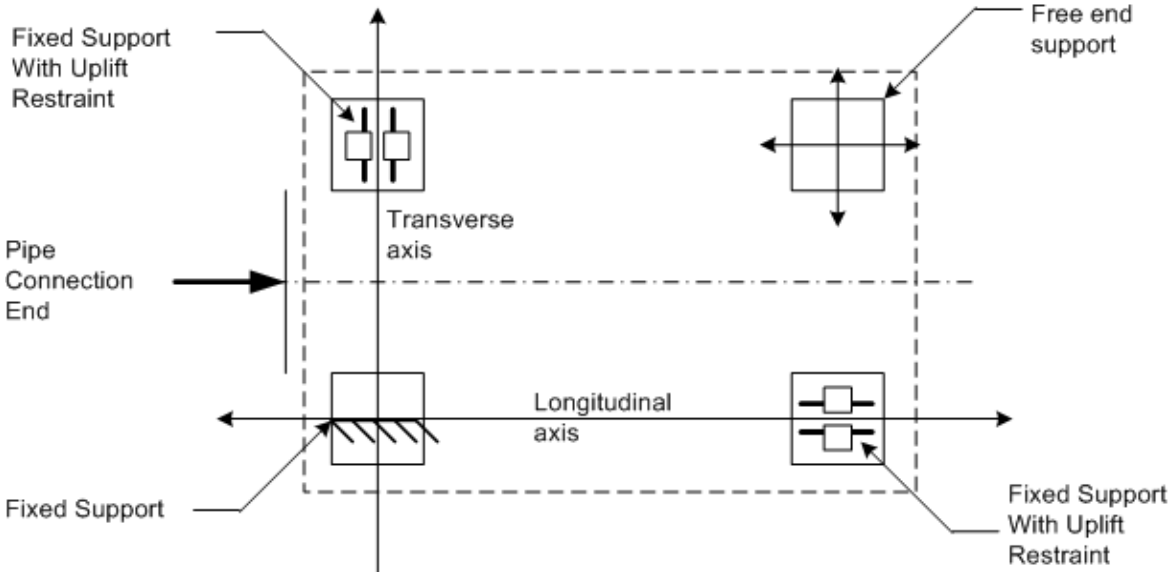
.5 diesel exhaust SCR emission control units.

.2 Fasten equipment to building structure to accommodate thermal expansion in accordance with manufacturer's instructions. In the absence of such instructions, fasten equipment support legs as follows unless otherwise shown;

.1 rigidly fasten one support point which is closest to piping connections,

.2 for supports located on the same transverse or longitudinal axis, provide guides with vertical restraint tabs, aligned in direction of fixed support point,

.3 for other support points, do not fasten or guide.



.3 Provide 3mm (1/8") thick PTFE (teflon) glide pads beneath each support leg.

END OF SECTION

20 05 02
PAINTING FOR MECHANICAL SERVICES

1 GENERAL

1.1 Scope

.1 Provide industrial anti-corrosion coatings for mechanical and electrical building services and related construction elements including:

.1 Mechanical and electrical services and supporting elements as specified under other sections of Divisions 20 to 25;

.2 Concrete curbs, housekeeping pads, floor trenches and containment floor areas.

.2 General painting of service room floors and decorative finish painting of building services is provided under Division 09.

1.2 Related Sections

.1 20 01 01 Mechanical General Requirements

.2 20 05 01 Mechanical Basic Materials and Methods

.3 23 11 23 Natural Gas Systems

1.3 Submittals

.1 Submit product data sheets which demonstrate compliance with LEED VOC requirements.

1.4 Applicable Codes and Standards

.1 Legislation:

.1 SOR/2009-264 Canadian Environmental Protection Act, Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations

.2 Installation standards and codes:

.1 LEED v4 New Construction, credit EQ Cr 4.2

.2 SSPC Society for Protective Coatings, Surface Preparation Standards

.3 Product standards:

.1 Green Guard GC-03 Green Seal Environmental Criteria for Anti-Corrosion Paints

2 PRODUCTS

2.1 Industrial anti-corrosion coatings – carbon steel materials

.1 Outdoor applications:

.1 For carbon steel materials and structural steel support components.

.2 Top coat: Industrial urethane alkyd enamel top coat, or single compound 100% acrylic coating.

.3 Primer coat: as per manufacturers' recommendation for coating of steel piping.

.4 Colour: Sherwin Williams No. SW4027 (Galvano), unless specified elsewhere.

.5 VOC limit: 340 g/L of product less water and excluded compounds.

Standard of Acceptance

- Sherwin Williams – Pro Industrial Urethane Alkyd Enamel
- Sherwin Williams – Pro Industrial Acrylic

.2 Indoor applications:

.1 For carbon steel materials and structural steel support components.

.2 Top coat: single compound 100% acrylic coating.

.3 Primer coat: as per manufacturers' recommendation for coating of steel piping.

.4 Colour: Sherwin Williams No. SW4027 (Galvano), unless specified elsewhere.

.5 LEED: certified to Green Guard standard GC-03 for anti-corrosion coatings.

.6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Pro Industrial Acrylic

.3 Zinc rich primer applications:

.1 For field painting of carbon steel material, or touch-up of galvanized steel material.

.2 Top coat: as specified for interior or exterior applications.

.3 Primer: single or multi-part zinc rich coating.

.4 Colour: gray-green.

.5 LEED: certified to Green Guard standard GC-03 for anti-corrosion coatings.

.6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Zinc Clad III HS 100

2.2 Industrial coatings – poured concrete trenches, curbs and floors

.1 Trenches, housekeeping pads, curbs and containment floors in service rooms:

.1 For field painting of concrete floor trenches, curbs and floor containment areas in service rooms.

.2 Resistant to fuel oil, general solvents and water.

.3 Top coat: water based urethane floor enamel

.4 Primer: water based epoxy

.5 Colour: Sherwin Williams Deck Gray

.6 Colour: Sherwin Williams Safety Yellow where shown.

.7 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Armorseal Floor Plex 7100 Primer / Amorseal 1K Topcoat

3 EXECUTION

3.1 General

.1 Refer to requirements for services to be painted in the relevant sections of Division 20 to 25 and as follows.

.2 Touch up any damage to factory prime coat resulting from shipping or installation with appropriate primer for indoor/outdoor installation with appropriate top-coat colour to match existing. Materials to be compatible with the original factory finish.

.3 Touch up any damage to factory galvanized finish resulting from site welding, shipping or installation with zinc rich primer.

3.2 Installation

.1 Surface preparation:

.1 Clean surfaces to be painted in accordance with paint manufacturer recommendations and as follows.

.2 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of paint materials.

.3 For carbon steel materials, remove all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing in accordance with SSPC-SP2 Hand Tool Cleaning.

.4 For galvanized steel material, solvent clean to SSPC-SP1 Solvent Cleaning. If galvanized surface is already rusty, remove loose rust and dirt in accordance with SSPC-SP2 and prime the exposed metal the same day as being cleaned.

.5 For concrete materials, clean surfaces to SSPC-SP13 / NACE 13 by mechanical, chemical or thermal methods.

.6 Tape-off adjacent materials which are not to be painted. Provide drop sheets to protect other material from falling paint or over-spray.

.2 Application - General:

.1 Apply one coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer.

.3 Apply top coat in the number of coats recommended by the manufacturer, to obtain 100% coverage to the minimum recommended thickness, free of streaks, drips and sags.

.4 Do not paint when temperature is lower than 7°C.

.3 Application – Galvanized base metal finish:

.1 Where material is galvanized, touch up welded sections or other locations where protective galvanized surface has been damaged, with zinc rich primer.

.2 Apply a top coat to match base material colour.

.4 Application – Concrete trenches, housekeeping pads, curbs and containment floors:

.1 Apply one coat of primer and two top-coats.

.2 Seal joints between curbs and containment floors with a silicone based industrial caulking in matching colour after paint has dried.

END OF SECTION

ELECTRIC MOTORS
20 05 12

1 GENERAL

1.1 Scope

.1 Provide single phase and three-phase low-voltage induction motors, from fractional horsepower (143T Frame) to 200 horsepower (449T Frame).

1.2 Operating and Maintenance Manuals

.1 Provide dimensioned shop drawings and additional motor information in form of "Motor Data Sheets".

.1 In addition to dimensioned motor prints, information collected and collated on Motor Data Sheets to be furnished as follows;

(a) Equipment number, and motor number to be used to identify motor, motor drawings and data sheets
(b) Motor model/catalogue numbers with applicable letter and/or number modifiers
(c) Motor full load current and rated voltage.
(d) Max KVAR allowed for power factor correction.
(e) HP/RPM/frame data.
(f) Induction motor time constants.
(g) Motor weight.
(h) Sliding base dimensioned drawings
(i) Bearing data.
(j) Guaranteed efficiency and power factor at full load, 75% load, 50% load, 25% load and 0%. (k) Acceleration time with maximum inertia
(l) Internal winding connection diagram.
(m) Speed torque performance data for across line start, from stand-still to synchronous speed. (n) "A Scale" weighted sound power levels.
(o) Installation and maintenance instructions.

1.3 Applicable Codes and Regulations

.1 Motors to be designed, manufactured, and tested in accordance with standards of:

.1 NEMA, ANSI, IEEE, and ASTM,

.2 conform with applicable sections of NEMA Standard No. MG-1 Motors and Generators.

2 PRODUCTS

2.1 General

.1 Test performance equal to or better than level required by Table 12-10 of NEMA MG-1 when tested to CSA 390 M Energy Efficiency Test Methods for Three Phase Induction Motors, or IEE 112b Standard Test Procedure for Polyphase Induction Motors and Generators.

.2 Motor nameplate rating:

.1 not less than input brake horsepower of driven equipment at specified operating condition,

.2 not less than minimum horsepower shown.

.3 Motor characteristics;

.1 Frequency: 60 Hz

.2 Voltage: as shown

.3 Speed: 1750 RPM or as shown.

2.2 Single Phase Motors

.1 Motors less than 375 W (½ HP):

.1 single phase,

.2 continuous duty,

.3 resilient mount, and

.4 built-in overload protection.

2.3 Three Phase Fractional Horsepower

.1 Motors of 375 W (½ HP) and 560 W (3/4 HP):

.1 three phase squirrel cage induction type,

.2 NEMA B:

(a) continuous duty,
(b) drip proof,
(c) ball bearing,
(d) Class B insulation, 40°C (104°F) ambient temperature.

2.4 Three Phase Motors for Service with Magnetic Starters

.1 Motors 745 W (1 HP) and larger for sine wave power supply.

.2 General:

.1 Open Drip Proof (ODP), NEMA T frame assembly

.2 NEMA Premium efficiency, general purpose duty type,

.3 suitable for horizontal, vertical or belt-driven mounting

.4 NEMA Design B, squirrel cage, induction type

.5 class B insulation, at 40°C (104°F) ambient temperature.

.6 1.15 service factor,

.7 3 leads for single voltage service.

.8 Two speed motors: six (6) lead motors.

(a) Five lead two-speed motors are not acceptable.

2.5 Three Phase Motors for Service with Solid Start Starters and Adjustable Frequency Drive's

.1 Motors 745 W (1 HP) and larger suitable for pulse width modulated wave form.

.2 General:

.1 Totally Enclosed Fan Cooled (TEFC), NEMA T frame assembly

.2 NEMA Premium efficiency, inverter duty type,

.3 suitable for horizontal, vertical or belt-driven mounting

.4 NEMA Design B, squirrel cage, induction type

.5 Fabricated and nameplated in accordance with NEMA MG-1 Part 31 for;

(a) 200% of full load starting torque
(b) Class F triple build winding insulation
(c) continuous duty
(d) 40°C (104°F) ambient temperature

.6 1.15 service factor,

.7 3 leads for single voltage service.

.8 Motor designed for grounding of stray rotor currents by application of electrically conductive bearing grease or rotor bearing brush assembly.

2.6 Enclosure, all motors

.1 Construction:

.1 cast iron, aluminum, or rolled steel construction,

.2 drain openings,

.3 shouldered lifting eye bolts,

.4 bi-directional, spark-proof, abrasion and corrosive resistant fan keyed to shaft,

.5 compression type grounding lug or double ended cap screw of silicon bronze, mounted in conduit box by drilling and tapping into motor frame

.2 Motor nameplate:

.1 Type 316 stainless steel,

.2 Mounted on enclosure with stainless steel fastening pins,

.3 information as described in NEMA Standard MG-1-20.60,

.4 motor bearing part numbers and motor wiring diagram indicated.

.3 Protective coating;

.1 primer and 4-5 mils epoxy overcoat on external surfaces, and corrosion resistant coating of epoxy paint on internal surfaces, shaft, rotor, stator iron, and end bells.

.2 shaft extension protected with rust preventive strippable coating capable of being peeled off or unwrapped.

.4 Motor termination boxes/leads:

.1 cast iron diagonally split, pipe tapped for conduit,

.2 attached to motor frame with cadmium plated hex head cap screws,

.3 arranged for conduit entry from either side or bottom,

.4 gaskets between box and motor frame and between halves of box,

.5 cover secured with cadmium plated hex head cap screws,

.6 box assembled to motor,

.7 motor leads in conduit box;

(a) identified in accordance with ANSI C6.1,
(b) with same insulation class as windings,
(c) sized in accordance with EASA recommended minimum ampacity values.

.8 motor leads between motor frame and termination box to pass through tight fitting neoprene rubber seal.

2.7 Three Phase Motor Construction for AFD and Solid State Starters

.1 Motor stator winding:

.1 made up with copper magnet wire coated with moisture resistant Class F, non-hygroscopic varnish with thermal rating of not less than 150°C for 30,000 hours life when tested in accordance with IEEE No. 57.

.2 insulation resistance greater than 100 megohms when measured at 25°C with 1000-volt direct current megohm bridge.

.3 held in stator slots that have had sharp edges and burs removed prior to winding insertion.

.4 coils phase insulated using Nomex paper, laced down.

.5 connection leads mechanically secured and silver soldered.

.6 designed for operation in either direction of rotation.

.2 Motor bearings:

.1 anti-friction single shield, vacuum-degassed steel ball bearings with;

(a) extended pipe zerk fitting, and ½-lb relief fitting for external lubrication while machine is in operation.
(b) bearing shield on motor winding side of bearing.
(c) rated fatigue life of L'-10 (B-10) 150,000 hours for direct coupled applications and 50,000 hours for belted applications.
(d) belted rating based on radial loads and pulley sizes from NEMA MG1-14.43.
(e) high quality bearing seal or Forsheda shaft slinger on outer or shaft end of bearing.

.2 lubricated at factory, after assembly, using zerk fittings to fill grease chamber and pipe extension

.3 Motor shafts and rotors

.1 Shafts:

(a) precision machined from high-strength carbon steel
(b) “standard long” for units 200-hp and smaller, for both direct connected drive duty and V-belt drives.

.2 rotor assemblies to be die cast aluminum, keyed, and shrunk or pressed to shaft using full shaft diameter for full length of rotor.

.3 shaft extension run out not to exceed 0.001" dial indicator reading measuring at right angles to shaft axis.

2.8 Sliding base for motors with V-belt drives:

.1 Construction:

.1 fabricated from steel as a single unit with double supported slide and two adjusting bolts.

.2 finished with coating as specified above for motor exterior.

2.9 Permissible Vibration

.1 Vibration velocity to be not more than 0.05 inches/second measured at bearing housing.

2.10 Sound pressure level:

.1 Not more than 85dbA, measured at 3 metres in accordance with IEEE publication No. 85.

.2 Motor manufacturer to ensure that motor is compatible with type of adjustable frequency generation to be supplied, and that system will be capable of providing rated torque over frequency range from
15 to 60 hz while operating within motor temperature rise specification.

.3 Motor to be capable of operating between 60 Hz and 90 Hz with torque reducing at drive frequency above 60 Hz.

2.11 Testing

.1 Test motor in accordance with IEEE 112 "Polyphase Induction Motors and Generators" to conform with NEMA MG-1.

.2 Additional tests may be performed on a random sampling of units supplied for the project as follows;

.1 insulation test to establish capability to withstand continuous phase-to-ground rms voltage of 1000 volts minimum for 30 minutes.

.2 winding to withstand 2500 volt AC phase-to-ground for one second.

.3 surge comparison test using 3000 volts AC phase-to-phase with submission of detailed comparison wave forms.

.4 shaft runout tests with results taken after motor is completely assembled.

.5 measurement of full load amperes, watts, power factor, RPM, and locked rotor current at rated voltage.

.6 verification of vibration status through velocity readings in inches/second taken at both ends of motor.

3 EXECUTION

3.1 Shipping

.1 Ship motors from factory;

.1 packed in Styrofoam or similar material or

.2 fastened to hardwood skid or pallet for fork truck handling

.3 protected against dirt and moisture during transit and outdoor storage.

.4 clearly identified with permanent ink marking on packing.

.2 Motors attached to equipment:

.1 protected against dirt and moisture during transit and outdoor storage.

.2 rotated by hand at one month intervals.

END OF SECTION

MOTOR STARTERS AND WIRING
20 05 13

1 GENERAL

1.1 Scope

.1 Provide constant and multi-speed motor starters and solidstate motor starters for electrical equipment provided under Division 20.

.2 Provide wiring, conduit and devices for mechanical services and electrical equipment provided under Division 20.

.3 Electrical wiring for Mechanical Trades work to be performed by specialist firm with an established reputation in this field.

1.2 Related Sections

.1 Electric Motors: to Section 20 05 12.

.2 Adjustable Frequency Drives: to Section 20 05 14.

1.3 Applicable Codes and Standards

.1 Comply with:

.1 Ontario Electrical Safety Code.

.2 CSA C22.1 Canadian Electrical Code.

.3 CSA Standard C22.1 No. 14 Industrial control equipment

.4 CAN/CSA-C22.2 No. 94 Special purpose enclosures

.2 National Electrical Manufacturers Association (NEMA) Standards relating to:

.1 single and three phase motors,

.2 wiring and,

.3 motor control.

1.4 Permits, Fees and Inspections

.1 Submit to Electrical Safety Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Consultant will provide drawings and specifications required by Electrical Safety Authority at no cost.

.4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.

.5 Furnish Certificates of Acceptance from Electrical Safety Authority and authorities having jurisdiction on completion of work to Consultant.

1.5 Standard details

.1 Device legend with list of abbreviations, schematic wiring diagrams for single and three phase motor starters and supplementary schematics are included at the end of this section.

.2 This material is to be used in interpretation of specification and schedule requirements for starters and motor control centres (MCC's), accessories within starter enclosures, motor and wiring protection components, and ancillary elements for power wiring and electrical control of Mechanical Trades equipment.

1.6 Shop Drawings

.1 Submit control wiring diagrams for electrical equipment provided under this Division.

.2 Wiring diagrams:

.1 in ladder diagram form with 215 mm (8½ in) space between 120-volt energized conductor on left and grounded conductor on right, and

.2 electrical contacts, relays, thermostats, timers and components in control circuits shown.

2 PRODUCTS

2.1 Magnetic and Manual Motor Starters

.1 General:

.1 Rating: NEMA

.2 Supply three phase starters from one manufacturer.

.3 size starters for rated for motor load plus additional 25 VA at 120 VAC for damper operator power supply.

.4 Provide wiring diagrams for control circuits where control wiring extends beyond starter enclosure

.2 Starters for single phase motors:

.1 2 pole manual type, or modified 3 pole magnetic type,

.2 where control elements for single phase motors are not rated for motor starting duty, provide separate 120 VAC control circuit and magnetic contactor rated for motor starting duty,

.3 combination switch with:

(a) overload relay,
(b) pilot light,
(c) control device terminations,
(d) NEMA 1 enclosure.

.3 Starters for three phase motors:

.1 Up to and including 45 kW (60 HP):

(a) combination magnetic type,
(b) magnetic contactor,
(c) HRC fused disconnect and fuses
(d) tin plated copper buswork for 22,000 Amp interrupting rating.

.2 Overload system:

(a) solid state, adjustable setting,
(b) wired with normally closed contact ahead of contactor holding coil, unless otherwise shown, (c) manual reset button,
(d) sized and set to suit characteristics of motor.

.3 Enclosure to CSA Standard C22.1 No. 94:

(a) Type 2 enclosure for indoor installations,
(b) Type 4 enclosure for outdoor installations,
(c) flange mounted disconnect handles on starter compartment.

.4 Operating controls:

(a) momentary push button, or three-position maintained contact rotary switch as required,
(b) four pole switch for Hand-Off-Auto control, with fourth pole use to monitor switch in Auto
position.

.5 Pilot lights:

(a) one cover mounted pilot light (green) to indicate motor running, (b) 120 VAC, push-to-test LED type.

.6 Provided with:

(a) auxiliary contacts or auxiliary relays to satisfy interlocking and automatic control requirements,
(b) 120 volt fused control transformers inside starter enclosure, sized for starter requirements plus an additional 25 VA for remote damper or valve actuator,
(c) engraved lamicoid nameplate identifying load served.

.7 Starters for motors equipped with temperature sensing devices in winding:

(a) compatible control unit supplied by motor manufacturer, installed in starter enclosure and connected into starter circuitry with relays, reset buttons, and pilot lights.

.4 Starters for multi-speed and/or reversing motors as specified for three phase starters and:

.1 motor starter control type as shown, with control interlocking to prevent simultaneous operation in multi-speeds or direction,

.2 adjustable time delay relays minimum 15 seconds between high-to-low-high speed, and between forward-reverse-forward direction, for operation in both BAS-Auto mode and local-Hand mode,

.3 two-speed single winding for 2:1 speed ratios, unless otherwise shown,

.4 two-speed, two-winding for speed ratios which are not 2:1.

2.2 Motor Thermal Protection

.1 Single phase motors mounted in air ducts, plenum chambers or in air stream inside air handling equipment:

.1 motor winding thermostats, normally closed contact, phenolic snap-acting disc thermal switch, temperature calibrated,

.2 automatic reset type.

Standard of Acceptance

- Texas Instruments - Klixon Phenolic Motor Protectors

.2 Three phase motors less than 37 kW (50 HP) mounted in air ducts, plenum chambers or in air stream inside air handling equipment:

.1 Winding sensors:

(a) three (3) Positive Temperature Coefficient (PTC) temperature sensors, one in each motor winding, wired in series, type compatible to control unit.
(b) winding sensors provided under section 20 05 12 Electric Motors

.2 Control unit:

(a) electronic motor protection module, single channel, 3 sensors per channel, (b) 120 VAC line power,
(c) manual reset.

Standard of Acceptance
- Texas Instruments - Klixon model 42AA100E

.3 Starter control wiring:

(a) control unit mounted inside starter enclosure,
(b) 120 VAC power to control unit,
(c) momentary normally-closed reset button located inside of starter enclosure,
(d) auxiliary output relay for safety interlock to motor contactor,
(e) red pilot light indicating high-winding temperature,
(f) 1 N.O. contact for remote alarm monitoring

.3 Three phase motors 37 kW (50 HP) and larger:

.1 Winding sensors:

(a) three (3) Positive Temperature Coefficient (PTC) temperature sensors, one in each motor winding, wired in series, type compatible to control unit.
(b) winding sensors provided under section 20 05 12 Electric Motors

.2 Control unit:

(a) temperature monitoring relay, single channel, 3 sensors per channel,
(b) 120 VAC line power,
(c) unit holds relay contacts on power supply failure,
(d) automatic/manual reset, with remote reset

Standard of Acceptance
- Siemens - 3RN10 12

.3 Starter control wiring:

(a) control unit mounted inside starter enclosure,
(b) 120 VAC power to control unit,
(c) momentary normally-closed reset button located inside of starter enclosure,
(d) test and test-reset button located on front of starter enclosure,
(e) auxiliary output relay for safety interlock to motor contactor,
(f) red pilot light indicating high-winding temperature,
(g) 1 N.O. contact for remote alarm monitoring.

2.3 Fuses for Motor Protection

.1 Fuses in starters to be CSA certified Form 1, current and energy limiting, time delay type, 200,000 ampere interrupting capacity with NEMA Class "J" rejection type mountings

Standard of Acceptance
- Ferraz Shawmut - Amp-Trap 2000-AJT
- Littelfuse-JTD_ID Series
- Bussmann-LPJ-SPI

.2 Size fuses installed in starters or in disconnect switches used in conjunction with magnetic starters, for branch circuit in accordance with Table D16 of Ontario Electrical Safety Code for time delay fuses and fuse manufacturer's recommendations.

.3 Provide one spare set of three fuses for each rating and type of fuse used.

2.4 Equipment Service Lights (Marine Lights)

.1 Pyrex globe, wire guard and 100 watt I.F. lamp

Standard of Acceptance
- Crouse Hinds - Type ARB-31
- Killark - Type VOBG-100

.2 Switches: 20 ampere, single pole, with neon pilot light, installed in cast metal condulet box.

Standard of Acceptance
- Smith & Stone - No. 4-4901

.3 Mount switches in accessible location on outside of plenum. Provide one switch for each fan system.

.4 Provide minimum of one marine light per 3 m (10 ft) width of plenum.

2.5 Wire type and size:

.1 Wire:

.1 RW-90 copper X-link type 600V insulation installed in conduit, sized to carry 125% of full load running current in accordance with Electrical Code:

(a) Minimum no. 12 gauge for power.
(b) Colour coded no. 14 gauge for control.

.2 AFD Inverter Duty:

(a) liquid tight, flexible metal conduit and cable to be specifically manufactured for this duty, (b) voltage rating: nominal 1000 V, and voltage spikes to 2000 V,
(c) 3 phase and 3 ground conductors.

Standard of Acceptance

- NEXANS - Drive Rx - Variable speed drive cable
- LAPP USA - OLFLEX® VFD SLIM; Severe duty power cable for AFD drives
- ShawCor - Shawflex VFD cable
- Rockbestos-Suprenant Cable - EXANE - VFD sheathed armoured power cable.

.2 Conduit :

.1 EMT and Rigid.

.2 Liquid-tight flexible metallic conduit.

.3 Grounding:

.1 Provide insulated green bonding conductor in each power and control conduit sized per Table 16 of the Electrical Safety Code. Minimum bonding conductor size #12AWG copper.

.4 Mineral Insulated Copper Cable (MICC):

.1 ULC listed 2 hour fire rating,

.2 shipped with ends temporarily sealed and stored under dry conditions,

.3 capacities and types noted on drawings and terminated using suitable terminating hardware,

.4 PVC jackets for embedded cables.

Standard of Acceptance
- Pyrotenax

3 EXECUTION

3.1 Wiring for Mechanical - General

.1 Electrical materials, equipment and installation procedures under Mechanical Division 20 to conform to Canadian Electrical Code as amended to date.

.2 Wiring methods and standards to conform with those specified in Electrical Division 26 for area of building in which installation is to be made.

.3 Use MICC cable for power and control wiring to motors and dampers, including local control devices such as limit switches, etc., comprising the following systems:

.1 stair pressurization systems,

.2 smoke venting, smoke evacuation, and aid to firefighting ventilation systems, and

.3 smoke dampers, combination smoke dampers.

.4 Use AFD Inverter Duty wiring between adjustable frequency drives (AFD) and associated motor.

.5 Conduit:

.1 EMT : Use thin wall conduit up to and including 32 mm (1 ¼ in) size for wiring in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury.

.2 Rigid : Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 40 mm (1½ in) size and larger. All wiring to be installed in conduit or approved raceway.

.3 Liquid-tight flexible: use only for last 1000 mm (3 ft) of motor feeder at connection to motor.

.6 Provide separate conduit for power wiring for each motor or starter. Do not install control wiring in the same conduit as power wiring.

3.2 Grounding

.1 Ground electrical equipment and wiring in accordance with Canadian Electrical Code and Local Authority's Rules and Regulations.

.2 Install grounding conductors, outside electrical rooms and electrical closets, in conduit and concealed.

.3 Make connections to neutral and equipment with brass, copper or bronze bolts and connectors.

.4 Ground all motors with separate green insulated copper ground conductor installed in power feeder conduit, wired from ground terminal in starter to a ground lug bolted directly to motor frame inside terminal box of motor. Size ground conductor per Table 16 of the Canadian Electrical Code. Minimum conductor size to be #12 AWG.

3.3 Disconnect Switches

.1 Motors:

.1 Provide disconnect switches for motor driven equipment provided under Division 20; (a) unfused: where line feeder is provided directly by Division 26,
(b) fused: where line feeder is provided by Division 20 from a splitter box, motor starter rack, or MCC.

.2 Location:

(a) Within 9 meters and line-of-site of motors serving non-refrigeration equipment.
(b) Within 3 meters and line-of-site of equipment containing refrigeration compressors, and equipment serving refrigeration compressors such as air-cooled condensers.

.2 Non-Motor Equipment:

.1 Provide disconnect switch for the following type of equipment provided under Division 20; (a) VAV terminal boxes

.2 Location:

(a) Immediately adjacent to equipment served.

.3 Disconnects for the above equipment may be provided by the equipment manufacturer.

3.4 Motor Winding Temperature Protection

.1 Coordinate with motor suppliers that the motor winding temperature sensors provided by the motor supplier is compatible with the thermal protection control units, as applicable.

.2 Provide control wiring between PTC sensors in three phase motors and control units in starters.

3.5 Equipment Service Lights (Marine Lights)

.1 Mount switches in accessible location on outside of plenum. Provide one switch for each fan system.

.2 Provide minimum of one marine light per 3 m (10 ft) width of plenum.

3.6 Division of responsibility - Provided by Mechanical Division 20:

.1 Provide the following work under Division 20. Trades providing or supplying equipment is responsible for termination of wiring in equipment.

.2 Motor starters:

.1 motor starters, and/or disconnect switch as required, together with remote "push-to-test" pilot lights and switches, for each motor or electrically connected item supplied under Mechanical Division 20,

.2 where starters and/or disconnects are grouped together, without MCC or Motor Control rack, provide and mount starters and/or disconnects on back board or panel,

.3 power wiring, conduit and fittings from load side of starters and or disconnects to motor or electrically connected item provided under Mechanical Division 20,

(a) for two speed starters, size both high and low speed conductors for capacity of high speed motor rating.

.4 wire final 300 mm to 450 mm (12 in to 18 in) of motor connections in flexible liquid tight conduit, with insulated throat connectors.

.3 Distributed equipment:

.1 power wiring from adjacent junction box to electric reheat coils, electric pipe heating systems, electric plumbing fixtures and trap seal primers, fan powered boxes, fan coil units, unit heaters and cabinet unit heaters,

.2 wiring and conduit from this junction box to connect starter, thermostat or other operating control and device being electrically powered,

.3 in mechanical rooms feed miscellaneous equipment from MCC 120 VAC distribution panels, unless otherwise shown.

.4 Terminal unit boxes:

.1 120 VAC power wiring from adjacent junction box, serving each group of 12 terminal boxes, and extend and connect to each terminal unit controller.

.2 exception: 3 phase, 208 V and higher voltages, provided by Division 26 direct to terminal unit box..

.5 Control power:

.1 control power including wire and conduit in service rooms:

(a) feed control power from dedicated normal power breaker panels which are provided by Division 26 in each main mechanical room,
(b) provide breaker protection and power wiring from breaker panels to controllers.

.2 control power including wire and conduit in all other areas:

(a) control power fed from adjacent junction boxes to group of control devices being electrically powered.

.3 control wiring, conduit and relays to interlock starters and connect safety and operating controls as shown.

.6 Plumbing fixtures;

.1 wiring and conduit from adjacent junction boxes to plumbing fixtures requiring control power.

.2 control transformers and low voltage wiring as required.

.7 Medical gas equipment;

.1 wiring and conduit from adjacent junction boxes to control and alarm devices being electrically powered.

.8 Equipment service lights (marine lights):

.1 wiring and conduit from adjacent junction boxes, and switches and fixtures.

.9 Power wiring to smoke dampers and combination smoke fire dampers:

.1 normal power as shown to each motorized smoke or combination smoke and fire damper.

.10 Smoke management/control of fans and dampers:

.1 By Division 26.

3.7 Division of responsibility - Provided by Electrical Division 26

.1 The following work is provided under Division 26.

.2 Motor starters:

.1 Conduit and power wiring to line side of remotely located starters and to line terminals of Motor Control Centres (MCC).

.2 For starters grouped together, without MCC or Motor Control rack: conduit, power wiring and splitters, and branch circuit wire and conduit up to line terminals in disconnect switches and/or starters.

.3 Distributed equipment:

.1 Power wiring to electric reheat coils, electric pipe heating systems, electric plumbing trap seal primers, fan powered boxes, fan coil units, unit heaters and cabinet unit heaters, terminated in a junction box installed adjacent to motor or device being connected, and

.2 junction boxes for above.

.4 Terminal unit boxes, supply and return:

.1 120 Volt, single phase power supply with a junction box for each group of terminal boxes with maximum of 12 terminal boxes fed from one junction box.

.2 3 phase, 208 V and higher voltages: separate feed and connection to each terminal unit controller.

.5 Control power for Division 20;

.1 120 Volt, single phase power supply with a junction box at each control device,

.2 junction boxes for above.

.6 Wiring to equipment service lights (marine lights):

.1 120 VAC power terminated in an outlet box on an adjacent wall, column or ceiling, and

.2 junction boxes for above.

.7 Fire Alarm System control of fans and dampers:

.1 FAS control modules located at/near each fan starter or damper actuator, and wiring between control module and damper motor and fan starter,

3.8 Wiring Diagrams

.1 Attached device legend and wiring diagrams to be read in conjunction with equipment specifications, control sequences, and motor/starter schedules for implementation of control sequences and identification of components required in each starter or AFD.

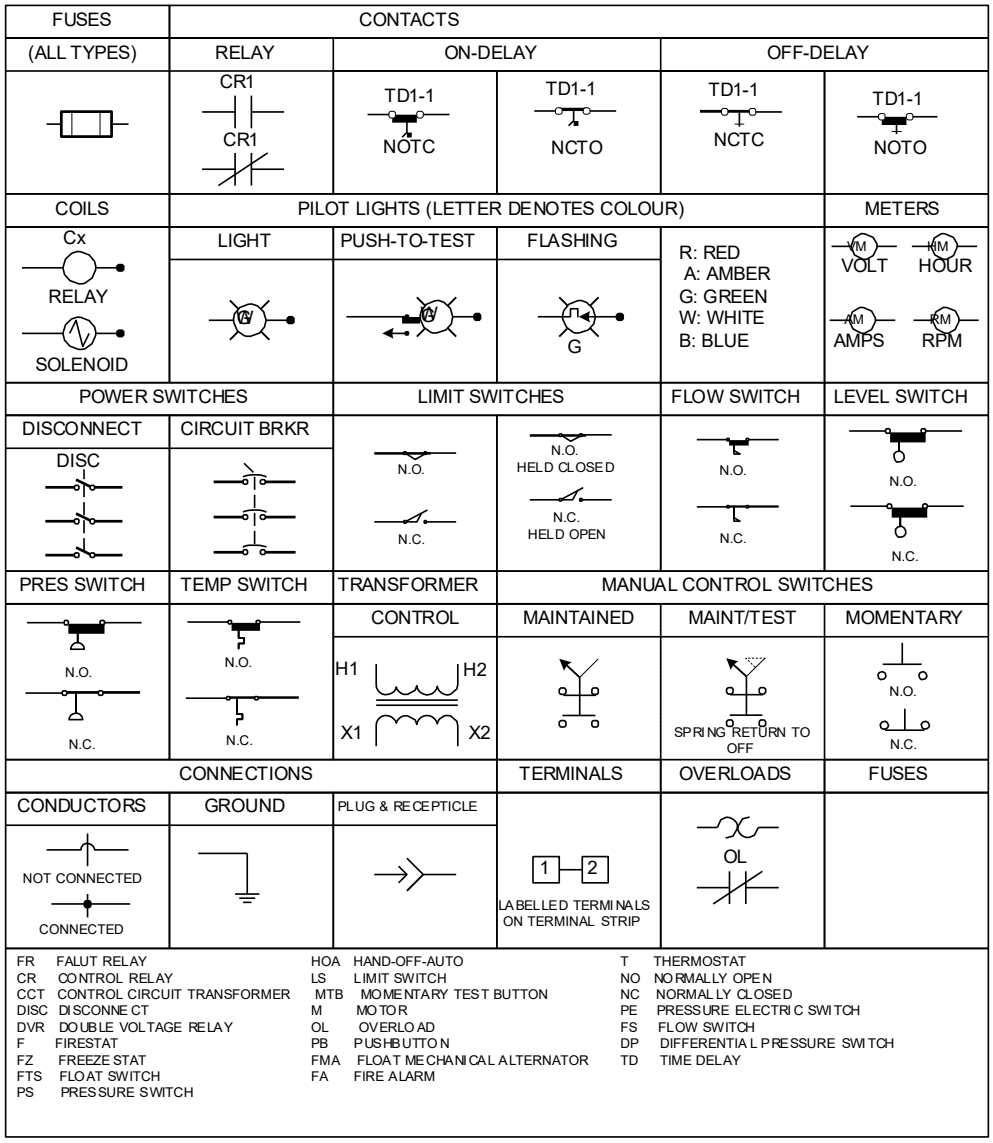
.2 Wiring from MCC or distribution panel to each AFD to be in individual, separate, rigid steel conduit.

Do not combine wiring from any other source within AFD conduit.

.3 Wiring diagrams following at end of this section:

.1	20 05 13 – 00	Device Legend	
.2	20 05 13 – 01	Type “A”	3 Phase - Start/Stop
.3	20 05 13 – 02	Type “B”	3 Phase - Hand-Off-Auto
.4	20 05 13 – 03	Type “BF”	3 Phase - Hand-Off-Auto - Dedicated Smoke Exhaust Fans
.5	20 05 13 – 04	Type “C”	3 Phase - Hand-Off-Auto - Duplex Lead-Lag Starters
.6	20 05 13 – 05	Type “AFD”	3 Phase - Adjustable Frequency Drive
.7	20 05 13 – 09	Motor Winding Temperature Protection (3 Phase)	
.8	20 05 13 – 11	Type “K”	1 Phase - On/Off
.9	20 05 13 – 12	Type “L”	1 Phase - Hand-Off-Auto
.10	20 05 13 – 13	Type “LF”	1 Phase - Hand-Off-Auto - Dedicated Smoke Exhaust Fans
.11	20 05 13 – 21	Mechanical – Electrical Coordination	

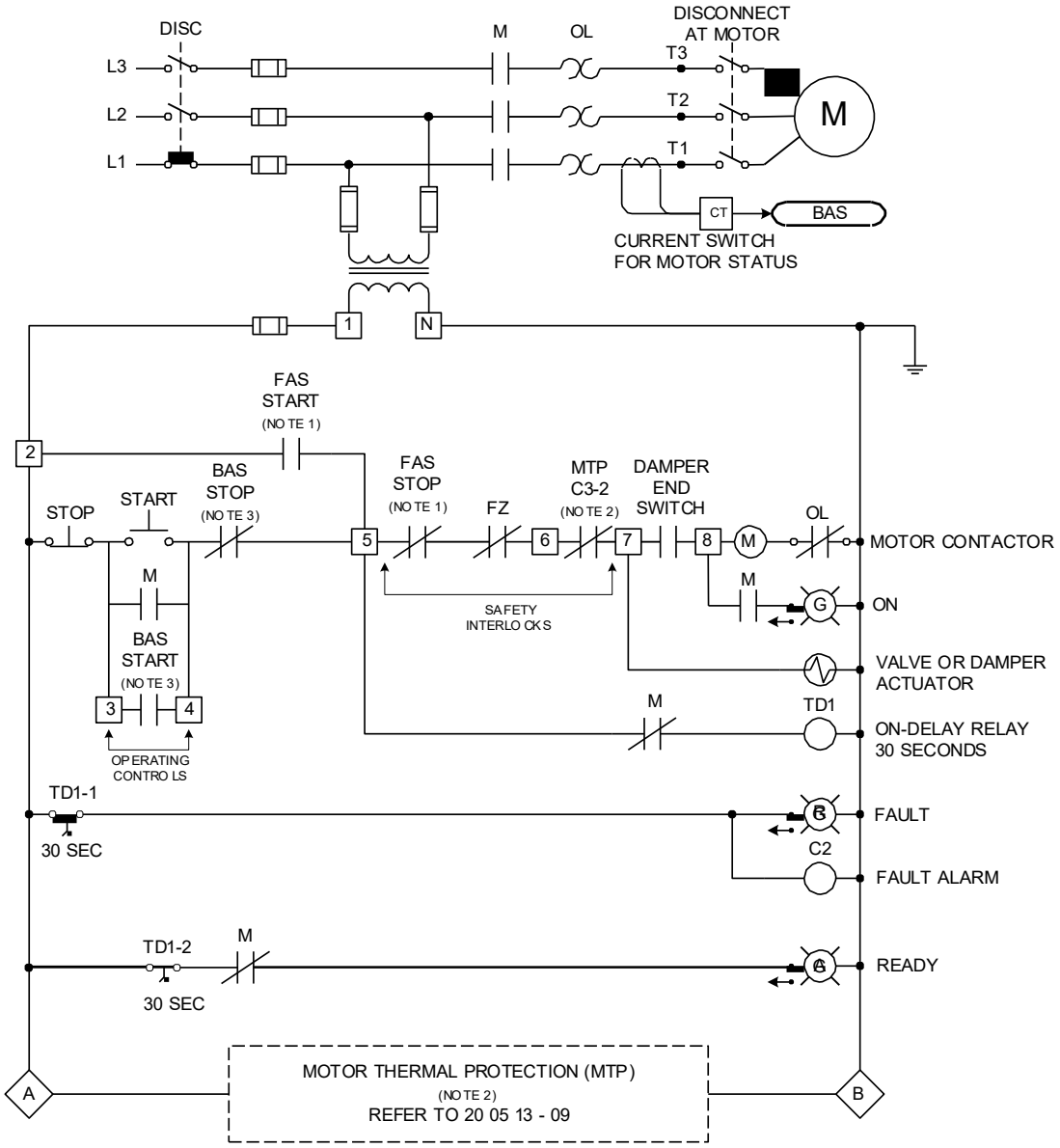
END OF SECTION



Sheet Title:
MOTOR STARTERS DEVICE LEGEND

Date:	Rev. No.:	Checked:
17-JAN-2017	01	RS

Standard Detail No.
20 05 13 - 00



NOTES:

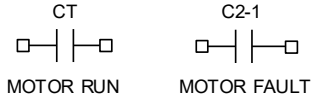
(1) ONLY REQUIRED WHEN THE FIRE ALARM SYSTEM IS DIRECTLY CONTROLLING THE STARTER.

(2) MOTOR THERMAL PROTECTION WHERE REQUIRED BASED ON MOTOR SIZE AND FUNCTION.

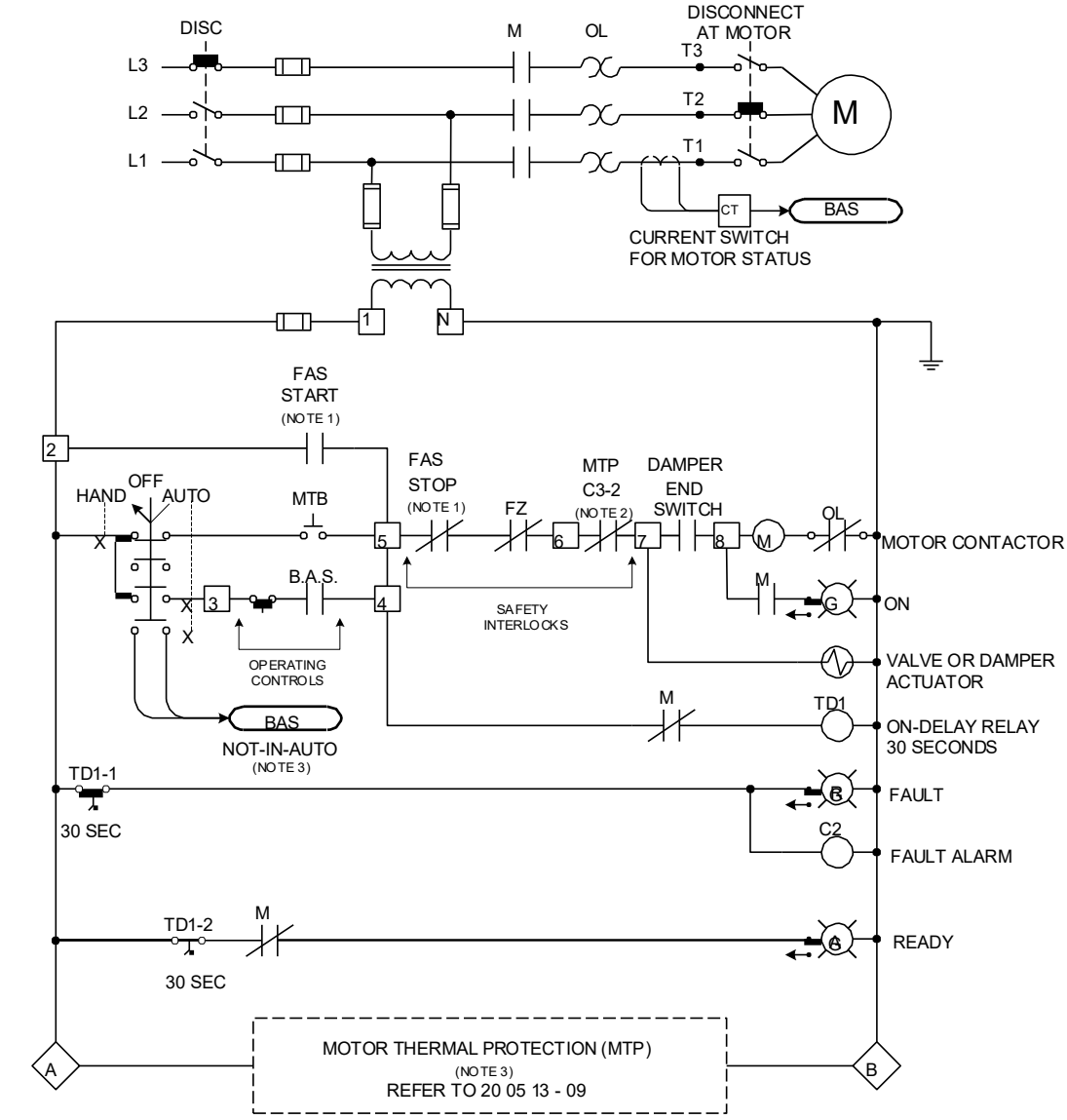
(3) BAS MOMENTARY OUTPUT

(4) COORDINATE STARTER SHOP DRAWINGS WITH MOTOR STARTER SCHEDULE FOR REQUIRED OPTIONS

BAS STATUS MONITORING



Sheet Title:	Date:	Rev. No.:	Checked:
TYPE “A” - MSS THREE PHASE STARTER	10-JAN-2017	01	RS
	Standard Detail No.		
	20 05 13 - 01		



BAS STATUS MONITORING

HOA — HOA NOT IN AUTO

CT — MOTOR RUN

C2-1 — MOTOR FAULT

NOTES:

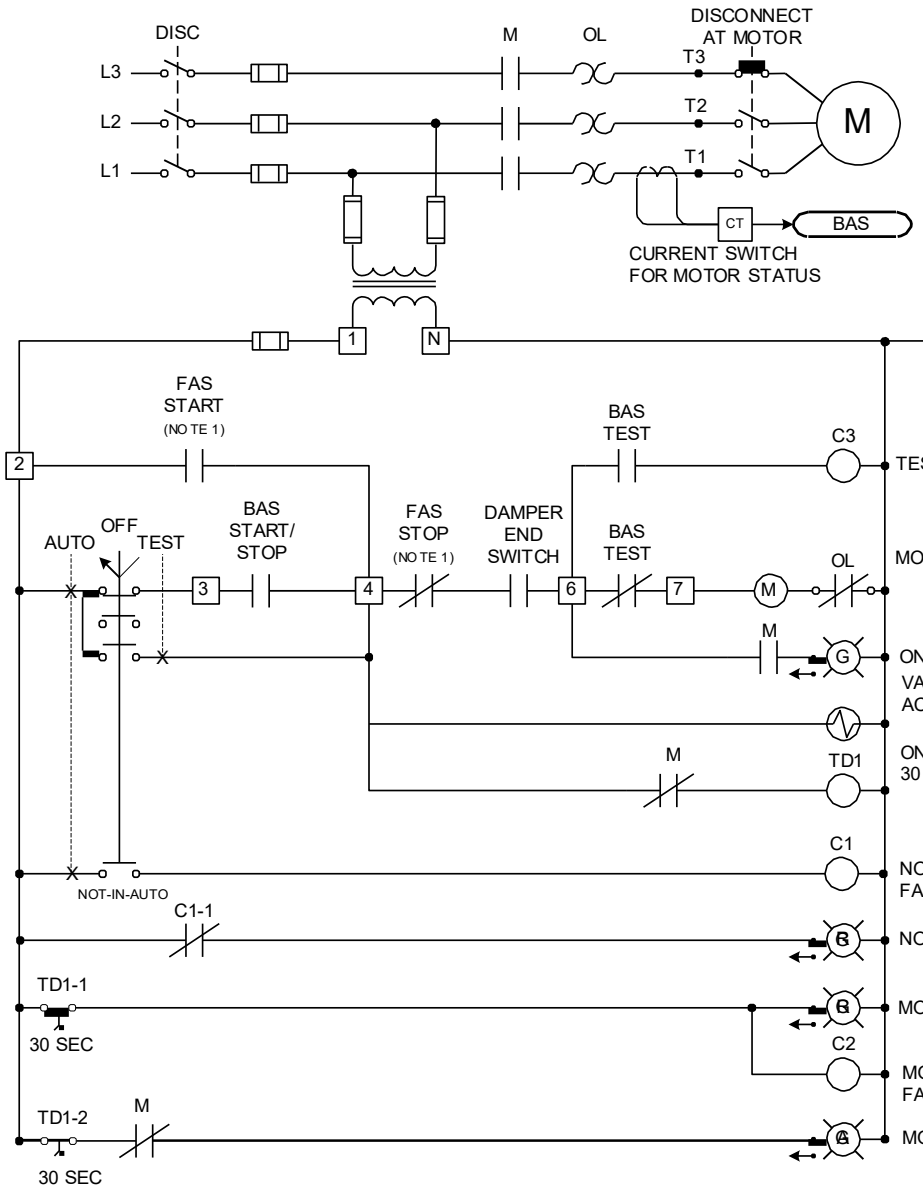
(1) ONLY REQUIRED WHEN THE FIRE ALARM SYSTEM IS DIRECTLY CONTROLLING THE FAN FOR SMOKE CONTROL

(2) MOTOR THERMAL PROTECITON WHERE REQUIRED BASED ON MOTOR SIZE AND FUNCTION.

(3) ONLY REQUIRED WHEN THE B.A.S. IS CONTROLLING THE FAN FOR SMOKE CONTROL OR AS OTHERWISE SHOWN

(4) COORDINATE STARTER SHOP DRAWINGS WITH MOTOR STARTER SCHEDULE FOR REQUIRED OPTIONS

Sheet Title:	Date:	Rev. No.:	Checked:
TYPE “B” - HOA THREE PHASE STARTER	9-JAN-2017	01	RS
	Standard Detail No.		
	20 05 13 - 02		



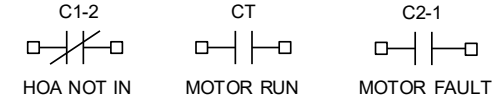
NOTES:

(1) ONLY REQUIRED WHEN THE FIRE ALARM SYSTEM IS DIRECTLY CONTROLLING THE FAN FOR SMOKE CONTROL

(2) ENERGIZING BOTH "BAS-START" AND "BAS-TEST" CONTACTS AT THE SAME TIME WILL TEST CONTROL WIRING INTEGRITY UP TO OPENING THE DAMPER, BUT WILL NOT START FAN.

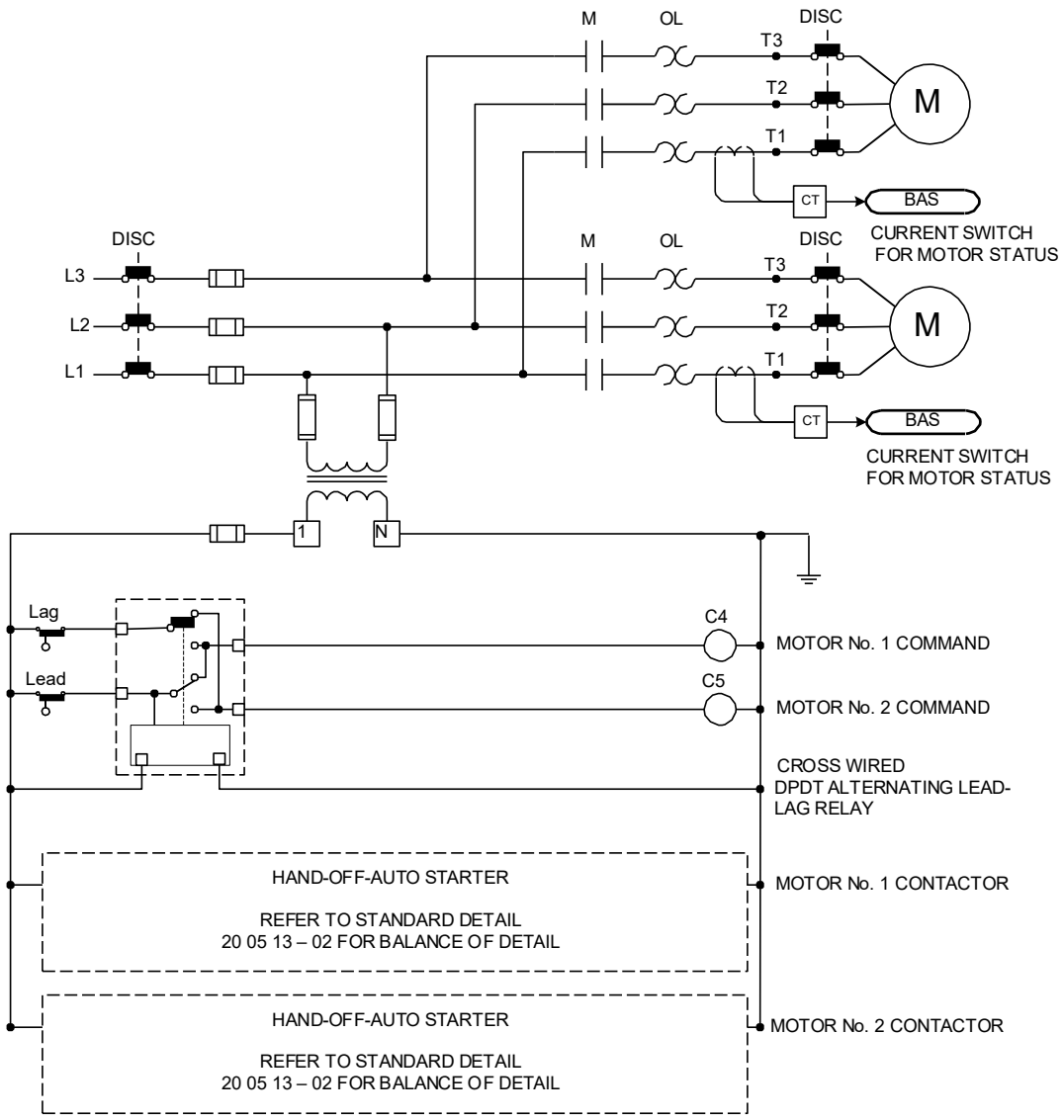
(3) COORDINATE STARTER SHOP DRAWINGS WITH MOTOR STARTER SCHEDULE FOR REQUIRED OPTIONS

BAS STATUS MONITORING



Sheet Title:	Date:	Rev. No.:	Checked:
TYPE "BF" - HOA DEDICATED SMOKE FANS THREE PHASE STARTER	9-JAN-2017	01	RS
	Standard Detail No. 20 05 13 - 03		

Issued for Tender



BAS STATUS MONITORING (EACH MOTOR)

HOA	CT	C2-1
HOA NOT IN AUTO	MOTOR RUN	MOTOR FAULT

NOTES:

(1) DUAL HAND-OFF AUTO STARTERS IN ACCORDANCE WITH STANDARD DETAIL 20 05 13 -02.

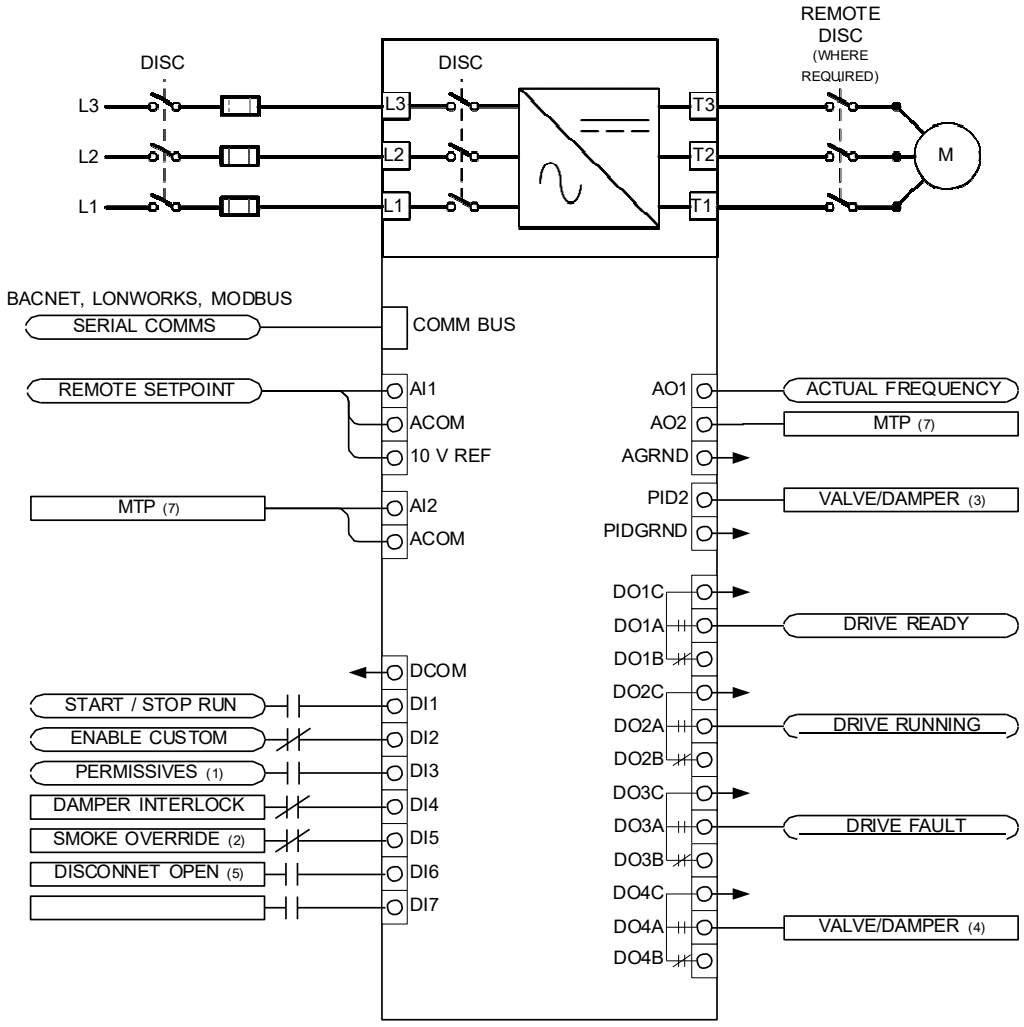
(2) SINGLE SOURCE POWER FEED.

(3) FLOAT SWITCHES SHOWN; REFER TO EQUIPMENT SCHEDULES FOR ACTUAL CONTROL DEVICE.

(4) NOT FOR FUEL OIL APPLICATIONS

(5) COORDINATE STARTER SHOP DRAWINGS WITH MOTOR STARTER SCHEDULE FOR REQUIRED OPTIONS

Sheet Title:	Date:	Rev. No.:	Checked:
TYPE “C” - HOA DUPLEX THREE PHASE STARTER	6-JAN-2017	01	RS
	Standard Detail No.		
	20 05 13 - 04		



NOTES

(1) PERMISSIVES INCLUDE FREEZE-STAT, FIRESTAT, HIGH PRESSURE LIMITS, ETC.

(2) FROM B.A.S. OR F.A.S.; MOTOR RUNS AT PRE-SET SPEED (ONLYUSED FOR NON-UUKL SMOKE CONTROL SYSTEMS)

(3) MODULATING CONTROL

(4) TWO POSITION CONTROL

(5) INTERLOCK TO REMOTE DISCONNECT SWITCH LOCATED ON LOAD SIDE OF DRIVE, TO PROVE SWITCH IS CLOSED.

(6) BYPASS FUNCTION (IF SPECIFIED) NOT SHOWN.

(7) MOTOR THERMAL PROTECTION SENSORS. IF NONE REQUIRED, MAY BE USED FOR OTHER I/O FUNCTIONS.

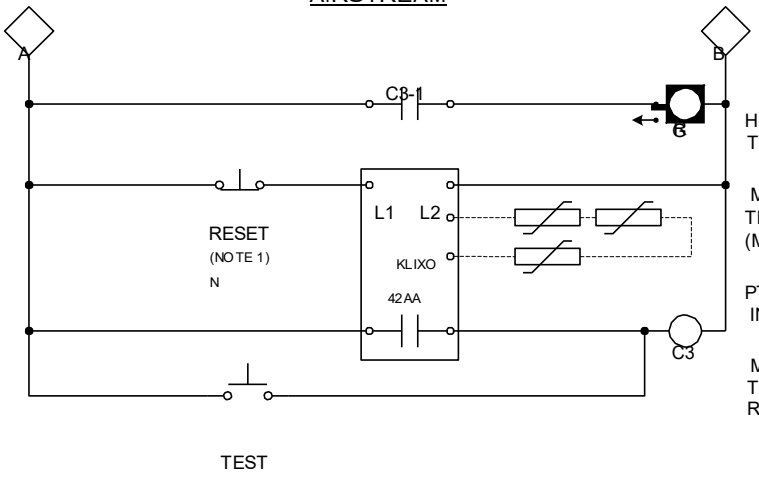
LEGEND

B.A.S. I/O

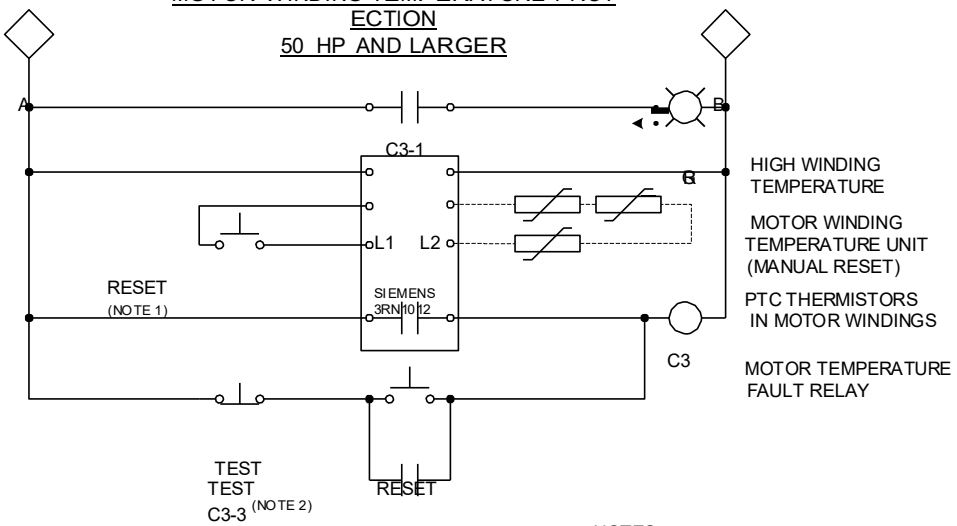
FIELD DEVICE I/O

Sheet Title:	Date:	Rev. No.:	Checked:
TYPE “AFD” ADUSTABLE FREQUENCY DRIVE	17-JAN-2017	01	RS
	Standard Detail No.		
	20 05 13 - 05		

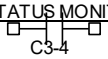
MOTOR WINDING TEMPERATURE PROT ECTION
< 50 HP, MOTOR LOCATED IN
AIRSTREAM



MOTOR WINDING TEMPERATURE PROT
ECTION
50 HP AND LARGER



BAS STATUS MONITORING



MOTOR THERMAL
FAULT

NOTES

(1.) RESET SWITCH LOCATED ON FRONT OF STARTER ENCLOSURE

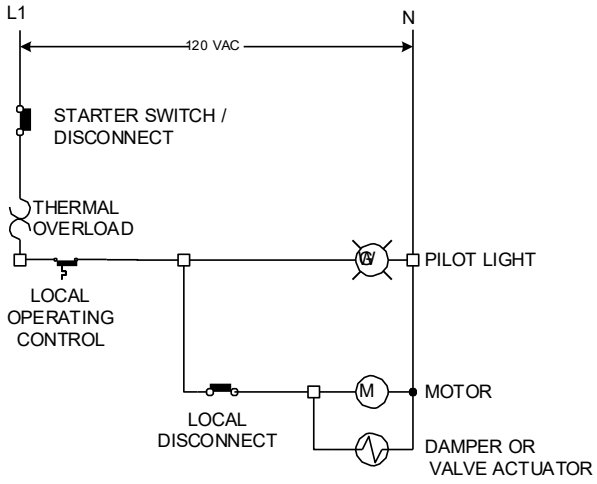
(2.) TEST AND TEST-RESET SWITCH LOCATED ON FRONT OF STARTER ENCLOSURE

(3.) REFER TO SEPARATE STANDARD DETAILS FOR MOTOR CONTROL REQUIREMENTS

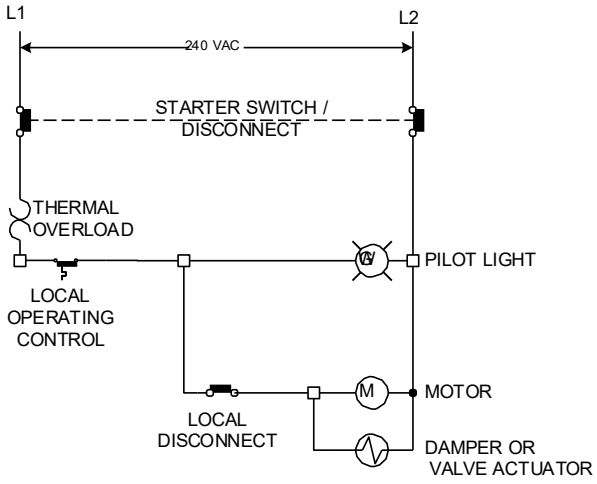
(4.) FOR THREE PHASE MOTORS ONLY. REFER TO SPECIFICATION FOR TYPES OF APPLICABLE INSTALLATIONS

Sheet Title:	Date:	Rev. No.:	Checked:
MOTOR THERMAL PROTECTION THREE PHASE MOTORS	11-JAN-2017	01	RS
	Standard Detail No.		
	20 05 13 - 09		

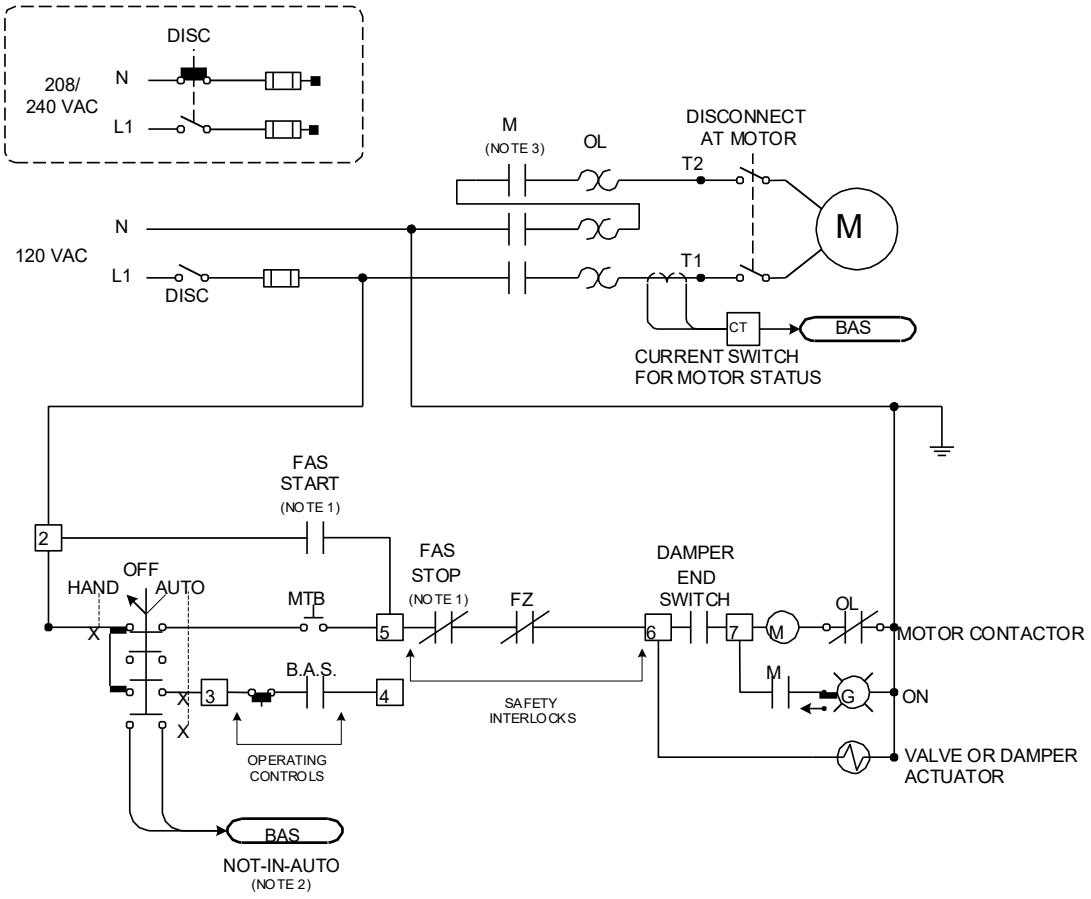
TYPE "K" STARTER – 120 VAC



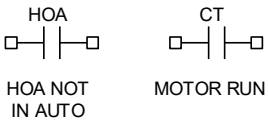
TYPE "K" STARTER – 240 VAC



Sheet Title:	Date:	Rev. No.:	Checked:
TYPE "K" - START/STOP SINGLE PHASE STARTER	17-JAN-2017	01	RS
	Standard Detail No. 20 05 13 - 11		



BAS STATUS MONITORING



NOTES:

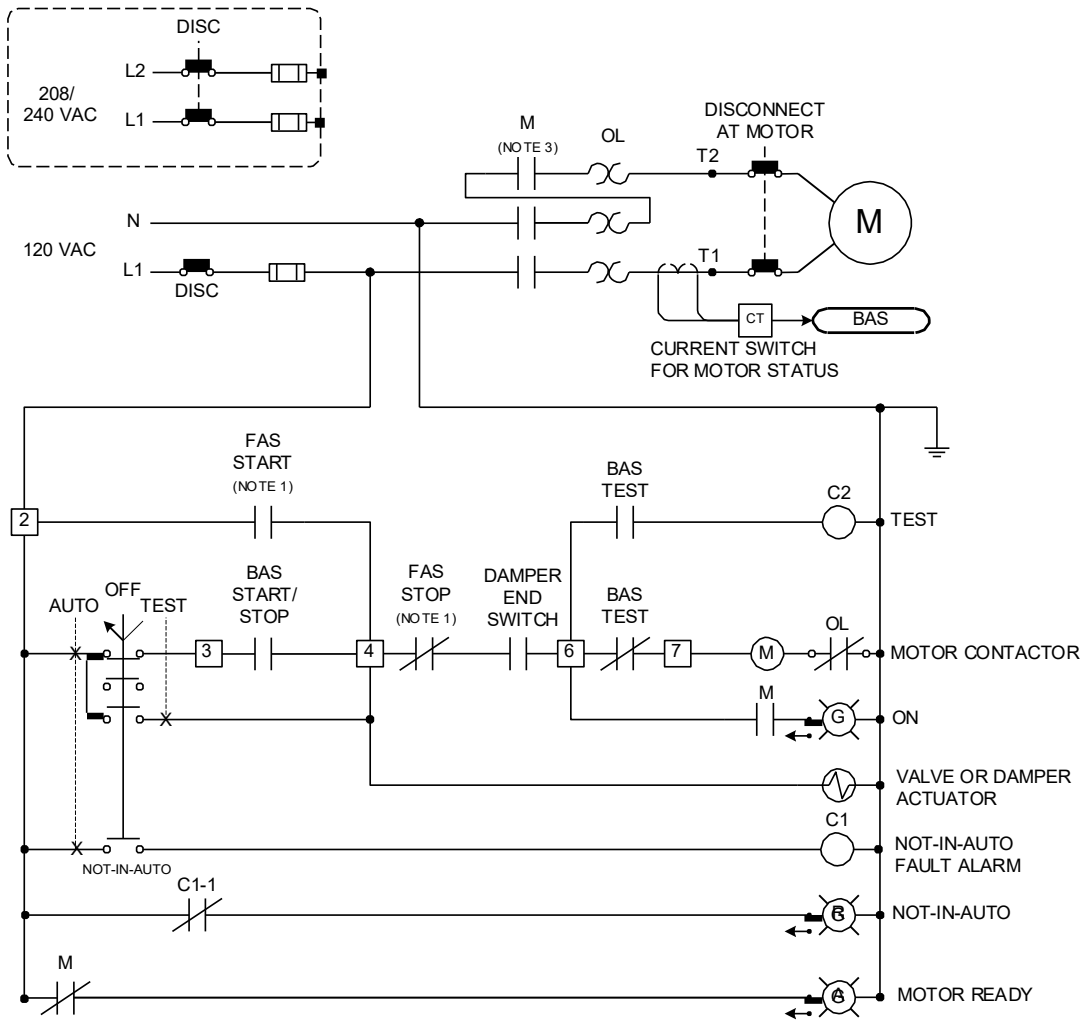
(1) ONLY REQUIRED WHEN THE FIRE ALARM SYSTEM IS DIRECTLY CONTROLLING THE FAN FOR SMOKE CONTROL

(2) ONLY REQUIRED WHEN THE B.A.S. IS CONTROLLING THE FAN FOR SMOKE CONTROL OR AS OTHERWISE SHOWN

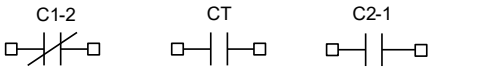
(3) MODIFIED THREE POLE CONTACTOR SHOWN; 2 POLE SINGLE PHASE CONTACTOR MAY ALSO BE USED.

(4) COORDINATE STARTER SHOP DRAWINGS WITH MOTOR STARTER SCHEDULE FOR REQUIRED OPTIONS

Sheet Title:	Date:	Rev. No.:	Checked:
TYPE “L” - HOA SINGLE PHASE STARTER	17-JAN-2017	01	
	Standard Detail No.		
	20 05 13 - 12		



BAS STATUS MONITORING



NOTES:

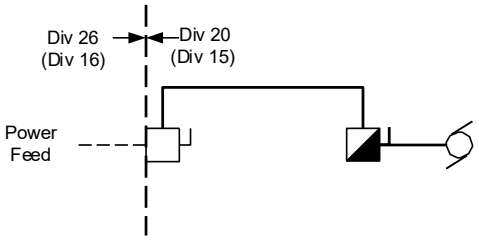
(1) ONLY REQUIRED WHEN THE FIRE ALARM SYSTEM IS DIRECTLY CONTROLLING THE FAN FOR SMOKE CONTROL

(2) ENERGIZING BOTH "BAS-START" AND "BAS-TEST" CONTACTS AT THE SAME TIME WILL TEST CONTROL WIRING INTEGRITY UP TO OPENING THE DAMPER, BUT WILL NOT START FAN.

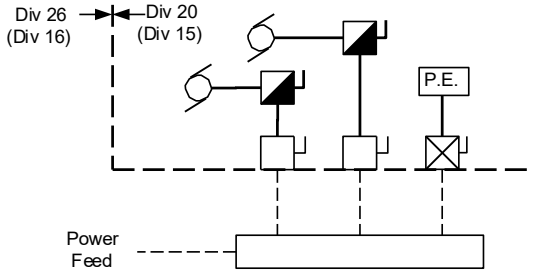
(3) MODIFIED THREE POLE CONTACTOR SHOWN; 2 POLE SINGLE PHASE CONTACTOR MAY ALSO BE USED.

(4) COORDINATE STARTER SHOP DRAWINGS WITH MOTOR STARTER SCHEDULE FOR REQUIRED OPTIONS

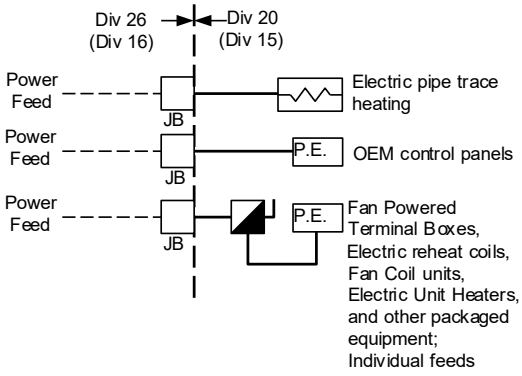
Sheet Title:	Date:	Rev. No.:	Checked:
TYPE "LF" - HOA DEDICATED SMOKE FANS	16-JAN-2017	01	RS
	Standard Detail No.		
	20 05 13 - 13		



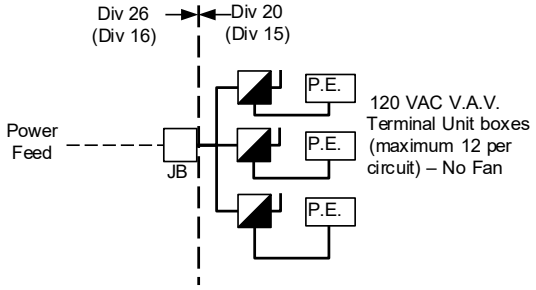
MCC's, Motor Control Racks and Single Starters



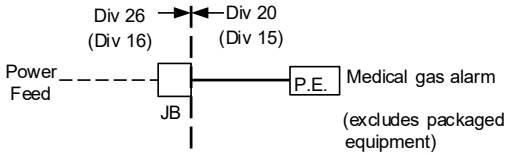
Grouped Starters, Disconnects Without a MCC or Motor Control Rack



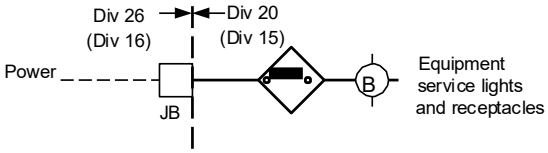
Distributed Equipment



VAV Terminal Units



Other Non-Motor Equipment



Equipment Service Lights

Legend

Combination Starter c/w fuse or circuit breaker

Motor

Switch

Unfused disconnect with padlocking means

Electric Heater

Beacon, Light or Horn

Fused disconnect with padlocking means

P.E. Packaged Equipment With integral starters

Wiring by Div 20

Wiring by Div 26

Junction Box

General Notes

This drawing indicates general coordination of mechanical and electrical work. Refer to drawings and specifications for details

Sheet Title:	Date:	Rev. No.:	Checked:
MECHANICAL – ELECTRICAL COORDINATION	17-JAN-2017	01	
	Standard Detail No.		
	20 05 13 - 21		

Issued for Tender

FLEX CONNECTIONS, EXPANSION JOINTS, ANCHORS & GUIDES
20 05 16

1 GENERAL

1.1 Scope

.1 Provide flexible connections, expansion joints, anchors and guides as shown.

1.2 Applicable codes and standards

.1 ASTM A53 Standard Specification for Pipe, Steel, Black and hot dipped, zinc-coated, welded and Seamless

.2 ASTM F1120 Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications

.3 ASME B31.1 Power Piping Code.

1.3 Design requirements

.1 Provide design services, sealed by a professional engineer licensed in the province of Ontario, for the design of pipe anchors including pipe stress design and resulting forces and moments at point of building attachment for the following pipe sizes and/or systems.

.1 any piping system using expansion joints,

.2	chilled water:	NPS 10 and larger
.3	condenser water:	NPS 10 and larger
.4	hot water heating, max 93°C (200 F):	NPS 8 and larger
.5	steam, low pressure <100 kPa (15 psig):	NPS 8 and larger
.6	steam >100 kPa (15 psig):	NPS 4 and larger

.7 glycol heating or cooling systems, in accordance with temperatures and pipe sizes described above.

1.4 Shop drawings

.1 Submit manufacturers product data sheets for expansion joint equipment showing

.1 Manufacturer, model number, piping service, pressure and temperature rating.

.2 Design allowances for axial, lateral and angular movement.

.3 Nominal size and overall dimensions.

.2 Submit sealed design drawings for pipe anchors, and include;

.1 plan drawings showing location of anchors and guides,

.2 fabrication details,

.3 pipe expansion forces,

.4 resulting reaction force and bending moments at building connection,

.5 building fastening details.

2 PRODUCTS

2.1 Slip type expansion joints:

.1 Application:

.1 for axial pipe movement,

.2 travel: 100 mm (4 in) to 300 mm (12 in) single unit, 200 mm (8 in) to 600 mm (24 in) for double units.

.3 size: NPS 1-1/2 to NPS 24

.4 Working pressure: 1030 kPa (150 psig) saturated steam.

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 body and packing housings: Class 150 carbon steel pipe to ASTM A 53, Grade B,

.2 wall thickness to match service pipe with flanges or weld ends to match service pipe jointing specification.,

.3 adjustable packing gland or fixed packing gland arrangement with a packing injection assembly, arranged for repacking under full line pressure.,

.4 slip pipe of carbon steel pipe to ASTM A 53, Grade B, hard chrome plated,

.5 anchor base constructed of steel welded to body on double units,

.6 internal and external guides in packing housing with concentric alignment of slip pipe,

.7 extension limit stop of stainless steel, with accessible and removable pins,

.8 not less than six packing rings of teflon or graphite impregnated material,

.9 lubricating fittings with grease nipple, pet cocks, and lubricant gun with hose assembly or plunger body of heavy wall carbon steel and plunger of carbon steel with hex head for use with socket wrench.

.10 lubricant: to manufacturer's recommendations. .

.11 drip connection coupling with drain plug.

- Flexonics – style “Slip Pakt”
- Yarway – style “Gun Pakt”
- Adsco – style “Ram Pak”
- Hyspan - style 6500
- Advanced Thermal System – style Thermal Pak
- Flexpression – style “Perma-Pax”

2.2 Controlled flexing expansion joints

.1 Application:

.1 for axial and lateral movements,

.2 travel: up to 190 mm (7.5 in) axial and 8 mm (1.5 in) lateral depending on size.

.3 size: NPS 3 to NPS 18

.4 Working pressure: 1030 kPa (150 psig) at up to 425°C (800°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 bellows hydraulically formed, type 304 stainless steel for specified fluid,

.2 two piece nickel iron reinforcing or control rings,

.3 flanges or weld ends to match service pipe jointing specification,

.4 austenitic stainless steel liner oriented with direction of flow ,

.5 carbon steel tie rods,

.6 carbon steel painted shroud .

Standard of Acceptance
- Flexonics – style CSF/CSW
- Adsco
- Metraflex
- Badger
- Flex-Hose Co
- Flexpression.

2.3 Externally pressurized expansion joints

.1 Application:

.1 for axial movements, as shown.,

.2 travel: 100 mm (4 in) to 200 mm (8 in) single unit, 200 mm (8 in) to 400 mm (16 in) double unit.

.3 size: NPS 2 to NPS 12

.4 Working pressure: 2070 kPa (300 psig) at up to 425°C (800°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 external pressurized design,

.2 housing: ASME A53 Gr B carbon steel,

.3 connections: ASME/ANSI B16.5 flanges, weld ends to ASME/ANSI B16.9, or grooved ends as applicable.

.4 bellows: hydraulically formed, three ply laminated, ASTM A240 T321 stainless steel for specified fluid,

.5 internal steel liner,

.6 internal and external guides.

Standard of Acceptance
- Flexonics – style SX/ DX
- Adsco
- Hyspan
- Metraflex
- Flex-Hose Co

2.4 Expansion compensators (bellows type)

.1 Application:

.1 for axial movements, as shown.,

.2 travel: 50 mm (2 in) to 75 mm (3 in) carbon steel, 50 mm (2 in) for copper.

.3 size: NPS ¾ to 4 for carbon steel, and NPS 3/4 to 3 for copper

.4 Working pressure: 2070 kPa (300 psig) at up to 400°C (700°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 external pressurized design,

.2 pipe: schedule 40 ASME A53 Gr B carbon steel,

.3 bellows: hydraulically formed, three ply laminated, ASTM A240 T321 stainless steel for specified fluid,

.4 connections:

(a) steel pipe: ASME/ANSI B16.5 flanges with floating flange as required, weld ends to ASME/ANSI B16.9, or grooved ends as applicable.
(b) copper tubing: female copper solder type ends for copper pipe,

.5 flow liner: ASTM A240 T304 stainless steel,

Standard of Acceptance
- Flexonics – style HS/HS/HB
- Adsco
- Hyspan
- Metraflex
- Flex-Hose Co

2.5 Braided equipment connector

.1 Application:

.1 for axial and lateral movements and vibration isolation at pumps and equipment,

.2 size: NPS 2 to NPS 10

.3 Working pressure: 1100 kPa (160 psig) at up to 121°C (250°F)

.4 factory tested to 1 ½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 Type 304 stainless steel corrugate internal liner with braided stainless steel cover,

.2 flanges: to ASTM A36 carbon steel, ASME/ANSI B16.5 class 150,

Standard of Acceptance
- Flexonics – series PCS
- Hyspan
- Metraflex
- Flex-Hose Co

2.6 Flexible rubber joints

.1 Application:

.1 for axial, lateral and angular movements,

.2 travel:

(a) axial: up to 55 mm (2¼ in) for double arch, and 19 mm (¾ in) for single arch
(b) lateral: up to 35 mm (1⅛ in) for double arch, and 9.5 mm (⅜ in) for single arch (c) angular: 35° for double arch, and 15° for single arch.

.3 size: NPS 1-1/2 to NPS 12 for double arch, NPS 14 to 20 for single arch.

.4 Working pressure: 1450 kPa (210 psig) at up to 37°C (100°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate

.2 Construction:

.1 spool type, reinforced EPDM inner liner and outer cover, with wire reinforced flange collars.

.2 NPS 1½ to 12: two filled arches with stabilizing ring,

.3 NPS 14 to 20: one filled arch.

.4 tie rod control units with vibration isolation washers,

.5 retaining rings, and

.6 neoprene covers.

Standard of Acceptance
- Flexonics – style 101/102
- Garlock Canada Limited - Style 204
- Metraflex
- Proco
- Flex-Hose Co

2.7 Flexible metal hose connections

.1 Construction:

.1 inner hose: corrugated T304 stainless steel,

.2 outer jacket: braided T304 stainless steel wire mesh,

.3 threaded or female soldered end connections up to NPS 2, flanged NPS 2½ and larger,

.4 selected for 1034 kPa (150 psi) working pressure and 93°C (200°F) working temperature,

Standard of Acceptance
- Flexonics
- Metraflex
- Flex-Hose Co
- Flexpression Ltd

2.8 Guides

.1 Construction:

.1 fabricated from steel

.2 guide spider clamped to pipe

.3 guide body with split bolted housing and angle bracket base.

Standard of Acceptance
- Flexonics Series PGT
- Adsco Model E
- Hyspan Series 9500
- Advanced Thermal System Type GA
- Flex-Hose Co
- Flexpression

3 EXECUTION

3.1 General

.1 Provide expansion loops in preference to expansion joints, where space permits.

3.2 Expansion joints installation

.1 Select expansion joints to compensate for thermal expansion in pipe between anchors with not less than 25% safety margin, calculating expansion based on the following operating temperatures;

.1 for heating systems, from -18°C (0°F) ambient up to maximum possible operating fluid temperature, but not less than 93°C (200°F) for water and design saturation temperature for steam,

.2 for cooling systems, from 15°C (60°F) ambient down to 5°C (40°F).

.2 Provide expansion joint types as follows:

Service	Limits	Type
Steam piping Boiler Feedwater piping	Over 1030 kPa (150 psig)	Slip
	501 - 1030 kPa (76 - 150 psig)	Slip, Ring Controlled or Externally Pressurized
	500 kPa (75 psig) and less	Ring Controlled or Externally Pressurized
Heating water piping Condensate piping Glycol heating piping Chilled water piping Glycol cooling piping Condenser water piping	NPS 20 and larger	Slip
	NPS 10 to NPS 18	Ring Controlled
	NPS 2 to NPS 12	Externally Pressurized
	NPS 4 and smaller	Expansion Compensator
Domestic Hot Water piping Domestic Recirculation Water piping	NPS 2 and larger	Externally Pressurized
	NPS 3 and smaller	Expansion Compensator
Domestic Cold Water piping	NPS 2 and larger	Externally Pressurized

.1 Support and guide piping adjacent to expansion joints;

.1 support piping on each side of expansion joint as specified herein,

.2 support expansion joint when provided with mounting supports,

.3 do not rely on pipe guides to support piping and expansion joint

3.3 Pump connectors

.1 Install pump connectors as shown and select connector types as follows:

Service	Pump Type	Limits	Connector Type
Heating pumps Glycol Heating pumps Condensate pumps	Base Mount	Flange NPS 6 to NPS 14	Bellows
		Flange NPS 4 and smaller	Braided
	Vertical In-Line	All	Braided
	Circulator	All	None required
Domestic Booster pumps	All	All	Braided
Sump pumps (sanitary and storm)	All	NPS 2-1/2 and larger	Braided
Fire pumps	All	All	None required

.1 Install pump connectors at;

.1 outlet only of sump pumps, and

.2 inlet and discharge side for all other pumps.

.2 For vertical-in-line pumps, install connector in vertical portion of piping; do not install connectors between valves and pump.

.3 For base mount pumps, install connectors at pump inlet and outlet flanges.

.4 Support and guide piping adjacent to pump connector to eliminate lateral misalignment; support piping independently from the connector.

3.4 Equipment connector installation

.1 Install equipment connectors on piping connections to equipment as shown and select connector types as follows:

Service	Limits	Connector Type
Domestic Hot Water Tanks	Inlet and Discharge piping NPS 3 and larger	Flexible Metal Hose
	Inlet and Discharge piping NPS 2 ½ and smaller	None required
Steam, heating and cooling coils, and humidifiers	Air handling units supported on spring vibration isolators	Flexible Metal Hose
	Other air handling units	None required

.2 Connector and hose sizing:

.1 nominal diameter: same size as pipe.

.2 length: selected at not less than manufacturers catalogued minimum active length for the configuration, and not more than 1.5 times this minimum recommended length.

.3 Support or guide piping firmly adjacent to equipment connectors and prevent pipes from swaying.

.4 Where equipment connectors are to be installed at steam coils, locate connectors;

.1 between control valve and coil on steam supply side, and

.2 after steam trap on condensate line.

.5 Where equipment connectors are to be installed at chilled and/or hot water coils, locate connectors;

.1 between strainer and coil on the supply side, and

.2 between coil and control valve on return side

.6 At reheat coils installed in terminal boxes or in ductwork, arrange equipment connectors so there are no bends, and no axial offsets greater than the OD of the connector measured from the centerline of the connector.

3.5 Piping anchors installation

.1 Design anchors suitable for locations shown;

.1 submit shop drawings sealed by a professional engineer licensed in the jurisdiction of the project,

.2 include connection loads to the building structure to be reviewed by the Structural Engineering Consultant

.2 Fabricate piping anchors from structural steel angles, channels, or plates secured directly to piping and the building structure unless otherwise shown:

.1 single leg design, for piping NPS 4 and smaller and where distance between side of pipe and building attachment point is 200 mm (8 in) and less,

.2 minimum four-contact point design for all other distances.

3.6 Pipe guides installation

.1 Design guides suitable for locations shown.

.1 submit shop drawings sealed by a professional engineer licensed in the jurisdiction of the project,

.2 include connection loads to the building structure to be reviewed by the Structural Engineering Consultant

.2 Guide locations:

.1 as shown, and

.2 for each expansion joint and expansion loop, provide two guides on each side of and adjacent to the joint or loop;

(a) locate the first guide within 4 x pipe diameters from joint or loop,
(b) locate the second guide within 10-14 x pipe diameter from first guide and additional guides as required to suite anchor design, and
(c) guide expansion joints as per expansion joint manufacturer requirements.

.3 Guide installation:

.1 factory fabricated type, pipe rolls, or structural steel shapes

.2 secured to building structure and arranged to restrict lateral displacement and bowing of pipe adjacent to expansion joint or loop,

.3 supported from building structure with structural steel angles, channels or plates,

.4 guide may be omitted between joint and anchor where an anchor is located within minimum distance in accordance with expansion joint manufacturer installation instructions.

3.7 Inspection of anchor and guide installation

.1 Make arrangements and pay for expansion joint manufacturer's field representative to review anchors and guides around expansion joints on;

.1 steam piping

.2 domestic hot water and recirculating water piping NPS 6 size and larger

.3 heating system and chilled water piping NPS 6 size and larger

.2 Submit written report, prepared by field representative, confirming that expansion joints, anchors, and guides are installed in accordance with joint manufacturer's recommendations.

3.8 Start-Up and Testing

.1 Prior to placing expansion joint in service, apply match-marks to joint flanges/connectors to record axial, lateral, rotation and angular movement of joint connections. After system is at operating temperature, inspect match-marks and record displacement of joint connections compared to pre- start conditions. Submit report including photos of displaced match-marks.

END OF SECTION

INDICATING GAUGES
20 05 19

1 GENERAL

1.1 Scope

.1 Provide temperature and pressure measuring devices and flow indicators as shown.

1.2 Shop drawings / product data

.1 Submit manufacturer's catalogue literature for;

.1 Flow indicators

.2 Thermometers

.3 Pressure gauges

.2 Include schedule of thermometers, and pressure gauges showing for each instrument:

.1 identification number,

.2 location,

.3 type,

.4 range and

.5 accessories.

1.3 Applicable codes and standards;

.1 ASME B40.200 Thermometers, Direct Reading and Remote Reading

.2 ASME B40.100 Pressure Gauges and Gauge Attachments

.3 ASME PTC 19.3 TW – Thermowells

.4 CSA B51 Boiler and Pressure Vessel Code

2 PRODUCTS

2.1 Flow indicators

.1 Construction:

.1 visual flow indication.

.2 equipped with dual flow scale calibrated in l/s and USGPM.

.3 protected against accidental breakage of the glass indicator.

.4 in-line type for pipe sizes up to NPS 1½.

Standard of Acceptance

- ITT Bell & Gossett - Thermoflow

2.2 Thermometers and Pressure Gauges - Selection Criteria

.1 General:

.1 normal operating reading to be between half and two thirds of full scale range and

.2 expected maximum and minimum readings to be within scale range.

.3 thermometers to have both Fahrenheit and Celsius scales.

.4 pressure gauges to have both psi and kPa scales.

.2 Product identification

.1 Pressure gauges and thermometers to be selected from manufacturer's standard product line.

Standard of Acceptance
- Trerice
- Dresser - Ashcroft
- Weksler - Baker Instruments
- Winter's Thermogauges
- Weiss
- WIKA

.3 Model designations from Trerice catalogue are used to establish quality standards and construction details to allow assessment of products from other unlisted manufacturers.

2.3 Direct reading thermometers

.1 Solar powered 178 mm (7 in) industrial, variable angle type, passivated thermistor, cast aluminum epoxy coated case, with solar cell and 11 mm (7/16 in) LCD display.

Standard of Acceptance
- Trerice SX9

.2 125 mm (5 in) bi-metal dial type, variable angle, stainless shell case and stem with calibration screw, to CGSB 14.5

Standard of Acceptance
- Trerice - B85600 Series

2.4 Remote reading thermometers

.1 115 mm (4½ in) liquid filled or gas activated type, stainless steel capillary, stainless steel spring armour, stainless steel bulb and phenolic, cast aluminum, or stainless steel case for surface mounting.

Standard of Acceptance
- Trerice - L80300 Series (liquid filled)
- Weskler - Baker Instruments - 413BE (gas activated)
- Dresser - Ashcroft 600A Series (gas activated)

2.5 Thermometer wells

.1 Construction:

.1 Body material:

(a) in copper pipe: brass.
(b) in steel pipe: stainless steel.

.2 threaded connection, manufactured from bar stock or forged brass with cap and

chain, compatible with temperature sensors used.

.3 pressure rating: 2000 kPa (300 psig) at 121°C (250°F)

.4 C.R.N. registered

Standard of Acceptance
- Trerice 5550 Series

2.6 Temperature well conversion kits

.1 Retrofit kit to convert straight liquid filled thermometer wells to accept bi-metal dial thermometers.

2.7 Pressure gauges

.1 For direct pressure measurement

.1 115 mm (4½ in) dial type, silicone-free dampening, black solid front case, ½% accuracy, adjustable pointer to ASME B40.100 Grade 2A.

Standard of Acceptance
- Trerice - 450B

.2 For differential pressure measurement

.1 115 mm (4½ in) dial type, silicone-free dampening, black solid front case, ½% accuracy, adjustable pointer and maximum registering pointer to ASME B40.100 Grade 2A, complete with impulse snubber and 3-way switching valve.

Standard of Acceptance
- Trerice - 450B

.3 Accessories:

.1 pressure snubbers, brass or T303 stainless steel construction:

Standard of Acceptance
- Trerice - 872

.2 needle valves, rising stem, brass or T316 stainless steel construction.

Standard of Acceptance
- Trerice - 735 / 740

.3 coil syphons, 1/4" NPT, welded 304SS Sch.40 body, 180° coil, 2060 kPa (300 psig) and 650°F max

Standard of Acceptance
- Trerice – 885

2.8 Test port plugs

.1 Piping test port plugs with gauge adaptors for pressure tests or insertion of pocket thermometer probes.

.1 material: brass or stainless steel T304.with BUNA N diaphragm core,

.2 size: 1/4” NPT to 1/2” NPT, with probe guard

.3 performance rating: 7000 kPa (1000 psi) from -40 to 150°C (-40 to 300°F)

Standard of Acceptance
- Winters – STP series

3 EXECUTION

3.1 Thermometer and Pressure Gauges - General installation criteria

.1 Install thermometers and gauges not more than 3 m (10 ft) from floor or platform, or install remote reading thermometers and gauges, with dial mounted at eye level, on steel or aluminum plate.

.2 Provide nameplates for each gauge and thermometer as specified in Section 20 19 00 Identification.

3.2 Thermometer installation

.1 Install thermometers in wells.

.2 Install wells with extension necks where piping and equipment to be insulated.

.3 Install thermometers on inlet and outlet of;

- .1 heat exchangers.
- .2 water heating and cooling coils.
- .3 water boilers.
- .4 domestic hot water tanks, and
- .5 as shown.

3.3 Pressure gauge installation

.1 Install pressure gauges on inlet and outlet of;

- .1 heat exchangers,
- .2 water heating and cooling coils,
- .3 steam piping to heating coils
- .4 water boilers,
- .5 domestic hot water tanks,
- .6 steam boilers,
- .7 condensate receivers,
- .8 deaerators, and
- .9 as shown.

.2 Install needle valves on pressure gauges.

- .1 For differential pressure gauge, provide needle valve on each sensing line.

.3 Install pressure snubbers on pressure gauges at;

- .1 suction and discharge sides of oil pumps, and positive displacement pumps,
- .2 compressed air; at compressors, dryers and receivers.

.4 Install coil syphons on steam and condensate pressure gauges.

3.4 Test port plugs

.1 Install test port plugs in locations as shown. Test port plugs shall not be used in lieu of temperature or pressure gauges specifically shown.

END OF SECTION

VALVES
20 05 23

1 GENERAL

1.1 Scope

.1 Provide valves in piping systems throughout project for shut-off service, manual balancing, and check-stops.

.2 Refer to relevant specification sections for specialty and control valves.

1.2 Applicable Codes and Standards

.1 Temperature and pressure ratings, material composition, and manufacturer's testing procedures conforming to latest specifications from:

.1 Manufacturers Standardization Society of Valve and Fittings Industry (MSS), and

.2 ASTM A216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service, or

.3 British Standards Institution (BSI) Kitemarks, or

.4 supplied by manufacturer operating with ISO 9001 certification.

1.3 Quality and Equivalence

.1 Valve selections are in general identified by model designations taken from manufacturers catalogues to indicate physical properties and quality standards not otherwise described.

.2 Companies, and/or trade names listed below are acceptable for various valve types, where products offered are essentially similar to those identified by manufacturer or model number under “Standard of Acceptance” designation.

.1 Specific duty valves are specified in each piping service article.

.2 for gate, globe, angle, and check valves

Standard of Acceptance
- Kitz
- Crane
- Newman Hattersley
- Jenkins
- Bonney Forge
- Dahl Bros
- Neo Valves
- Nibco
- Trueline
- Toyo Valves (Red &White)
- S.A. Armstrong
- Velan
- Watts
- A-Chem Valves & Controls

.3 for double regulating valves
- S.A. Armstrong
- Tour & Anderson

- Preso
- Newman Hattersley

.4 for silent check valves

Standard of Acceptance
- Valmatic
- APCO
- Durabla
- Nibco
- Mueller

.5 for butterfly valves

Standard of Acceptance
- Crane Centreline
- Crane Flowseal
- Kitz
- Mueller
- Crane
- Keystone
- Demco
- Newman Hattersley
- Grinnell
- DeZurik
- Apollo
- Milwaukee Valve
- Bray
- Jenkins
- Nibco
- Watts
- Challenger
- Velan
- A-Chem Valves & Controls
- Sure Seal

.6 for ball valves

Standard of Acceptance
- American Valve
- Kitz
- Crane
- Newman Hattersley
- Jenkins
- Apollo
- Dahl Bros
- Neo Valves
- Milwaukee Valve
- Nibco
- Canadian Worcester Controls
- Toyo Valve (Red&White)
- Watts
- Velan
- A-Chem Valves & Controls
- Trueline

.7 for grooved piping valve products

Standard of Acceptance
- Victaulic
- Nibco
- Gruvlok
- Couplox
- Mueller
- Shurjoint

2 PRODUCTS

2.1 Selection criteria

.1 Valves to be line size, selected as follows

.1 for shut-off or isolating service, valves to be

(a) Gate
(b) Butterfly
(c) Ball or
(d) Plug

.2 for flow balancing and shut-off service valves to be

(a) Double regulating, or
(b) Plug and
(c) to incorporate adjustable limit stops.

.3 at discharge of pumps check valves to be silent or spring assisted or combination check and flow control valves.

.2 On mains and risers, drain valves to be selected as follows

.1 On mains NPS 4 and under

(a) NPS ¾ brass threaded ball valve of appropriate pressure rating with hose thread, cap and chain.

.2 On mains NPS 5 and over

(a) NPS 1 brass threaded ball valve of appropriate pressure rating with hose thread, cap and chain.

2.2 Sprinkler and standpipe valves

.1 Approvals

.1 Valves to be ULC and FM listed for fire protection.

.2 Gate valves up to NPS 2, threaded

.1 1200 kPa (175 psi) Class 150 bronze body, solid wedge bronze disc, rising stem, OS & Y, screw in yoke bonnet,

Standard of Acceptance
- Crane 459
- Nibco T-104-0

.3 Gate valves NPS 2½ and over, flanged

.1 1200 kPa (175 psi) to ASTM A216 class B, 175 CWP non shock, cast iron body with flat face flanges, bronze or bronze faced solid wedge disc, bronze seat rings, rising stem, OS & Y, bolted bonnet

- Crane 467
- Jenkins 825CJ
- Nibco F-607-OTS

.4 Butterfly valves up to NPS 2½, threaded

.1 1200 kPa (175 psi), bronze body, stainless steel disc, with lever handle

Standard of Acceptance
- Milwaukee BB2-100
-

.5 Butterfly valves NPS 2½ and over, lug style

.1 1200 kPa (175 psi), cast iron body, ductile iron disc nickel plated, EPDM seat, "OPEN/SHUT" indicator

Standard of Acceptance
- Grinnell X8292ULOS
- Nibco LD3510-4
- Sure Seal 600 Series

.6 Butterfly valves NPS 2½ and over, grooved joint style

.1 1200 kPa (175 psi), cast iron body, EPDM coated or brass disc, EPDM seat, "OPEN/SHUT" indicator, with supervisory switch

Standard of Acceptance
- Nibco G-4765-8N
- Gruvlox 7700
- Victaulic Series 705W

.7 Swing check valves NPS 2½ and over, flanged

.1 1200 kPa (175 psi),to ASTM A216 class B, 175 CWP, cast iron body with flat faced flanges, regrind, renew bronze disc and seat ring, bolted cover,

Standard of Acceptance
- Crane 375
- Jenkins 477J
- Nibco F-908-W

2.3 Domestic water valves

.1 Gate valves NPS 2 and under, soldered

.1 1000 kPa (150 psi),to MSS SP-80, Class 150,bronze body, solid wedge bronze disc, rising stem, screw in, or union bonnet.

Standard of Acceptance
- Kitz 43
- Crane 1334
- Jenkins 813J
- Newman Hattersley T608 with NPT to copper adapters

- Nibco S-131

.2 Gate valves NPS 2 and under, threaded

.1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, solid wedge disc, rising stem, screw in, or union bonnet.

Standard of Acceptance
- Kitz 42
- Crane 431
- Jenkins 281OJ
- Newman Hattersley T608
- Nibco T-131

.2 1000 kPa (150 psi) to 2000 kPa (300 psi), to MSS SP-80, Class 300, bronze body, solid wedge disc, rising stem, union or screw in bonnet.

Standard of Acceptance
- Kitz 37
- Crane 634E
- Jenkins 228OUJ
- Newman Hattersley #C1174
- Nibco T-174A

.3 Globe valves NPS 2 and under, soldered

.1 850 kPa (125 psi), to MSS SP-80, 300 CWP, bronze body, renewable composition PTFE disc, threaded over bonnet, lock shield handles as indicated.

Standard of Acceptance
- Kitz 10
- Crane 1334/1320
- Jenkins 813J
- Newman Hattersley 13 with NPT copper adaptors
- Nibco S-235-Y

.4 Globe valves NPS 2 and under, threaded

.1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, renewable composition PTFE disc, union bonnet, lock shield handles as indicated.

Standard of Acceptance
- Kitz 09
- Crane7TF
- Jenkins 106BJ
- Newman Hattersley 13
- Nibco T-235-Y

.5 Butterfly valves NPS 2 to NPS 12, flanged

.1 1378 kPa (200 psi) to MSS-SP-67, cast iron lug body style with holes drilled and tapped for ANSI 125/150 flange pattern;

(a) stainless steel shaft, aluminum bronze or 316 stainless steel or ductile iron/nickel plated disc, and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.

(b) ANSI 150 temperature and pressure rating and suitable for working pressures up to 1378 kPa (200 psi) at 100°C (212°F), factory tested to minimum of 2067 kPa (300 Psi) at 37.8°C (100°F)

(c) with locking handles up to NPS 4 and gear operators for NPS 6 and over.

Standard of Acceptance
- Crane Center Line - Series 200
- Kitz - 6122E
- Colton - CILB Series
- Nibco LC-2000
- Challenger #20CN4E
- DeZurik BOS
- Watts BF
- SureSeal 600

.2 1720 kPa (250 psi) to MSS-SP-67, cast iron lug body style with holes drilled and tapped for ANSI 125/150 flange pattern;

(a) stainless steel shaft, aluminum bronze or T316 stainless steel disc, and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.
(b) ANSI 150 temperature and pressure rated and suitable for working pressures up to 1720 kPa (250 psi) at 37.8°C (100°F), factory tested to minimum of 2067 kPa (300 Psi) at 37.8°C (100°F).
(c) with locking handles up to NPS 4 and gear operators for NPS 6 and over.

Standard of Acceptance
- Crane Center Line – Series 225
- Kitz – 6123E
- Nibco – LD-3010

.3 High performance type for working pressures up to 4800 kPa (740 psi), ANSI B16.34 temperature and pressure rated carbon steel lug body with holes drilled and tapped for ANSI Class 300 flange pattern.

(a) 316 or 17-4 stainless steel disc and shaft, Teflon seat complete with titanium or 316 stainless steel spiral wound back-up ring to provide bubble tight shut-off under system pressure from either side, when installed with single flange.
(b) with locking handles up to NPS 4 and gear operators for NPS 6 and over.
(c) ANSI 300 temperature and pressure rated and suitable for working pressures up to 4823 kPa (740 psi) at 37.8°C (100°F), factory tested to minimum of 4823 kPa (740 psi) at 37.8°C (100°F)

Standard of Acceptance
- Crane Flowseal
- DeZurik BHP Series
- Keystone K-Lok Series
- Mueller
- SureSeal

.6 Butterfly valves NPS 2 to NPS 12, for roll grooved piping

.1 2000 kPa (300 psi), Class 300, Iron body, grade E dual seal disc, with lever handle up to NPS 3 and gear operators NPS 4 and up.

.2 Suitable for mounting motorized control actuators.

Standard of Acceptance
- Victaulic - Vic 300 Master seal for steel pipe
- Gruvlok - 7700 for steel pipe

- Nibco GD-4765 for steel pipe
- Victaulic - Vic 608 for copper pipe
- Gruvlok - 7721 for copper pipe
- Mueller - 59G

.7 Swing check valves NPS 2 and under, soldered

.1 850 kPa (125 psi), to MSS SP-80, bronze body, bronze swing disc, regrindable seat, screw-in cap,

Standard of Acceptance
- Kitz 23
- Crane 1342
- Jenkins4093J
- Newman Hattersley 47 with NPT copper adaptors
- Nibco S-413

.8 Swing check valves NPS 2 and under, threaded

.1 850 kPa (125 psi), to MSS SP-80, Class 125, bronze body, bronze swing disc, regrindable seat, screw-in cap

Standard of Acceptance
- Kitz 22
- Crane 37
- Jenkins 4073J
- Newman Hattersley 47
- Nibco T-413

.9 Swing checks NPS 2 ½ and over, flanged

.1 850 kPa (125 psi), to MSS SP-71, Class 125, cast iron body with flat faced flange, renewable bronze seat rings, bronze faced iron or bronze disc, bolted cap.

Standard of Acceptance
- Kitz 78
- Crane 373
- Jenkins 587J
- Newman Hattersley 651
- Nibco F-918

.10 Swing check valves NPS 2 and over, grooved:

.1 2065 kPa (300 psig), ductile iron body with spring-assisted disc.

Standard of Acceptance
- Victaulic series 719, NPS 2 ½ to 4
- Victaulic series 779, NPS 4 to 14

.11 Ball valves up to NPS 2:

.1 1000 kPa (150 psi), two piece bronze body and chrome plated bronze ball, PTFE seat rings, solder joint or NPT to copper adapters, full port.

.2 handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

Standard of Acceptance
- Kitz 59(soldered)
- Kitz 58 (threaded)

- Crane 9322 (soldered)
- Crane 9302 (threaded)
- Jenkins 202J (soldered)
- Jenkins 201J (threaded)
- Newman Hattersley 1999 (soldered)
- Newman Hattersley 1969F (threaded)
- Nibco S-FP-600 (soldered)
- Nibco T-FP-600 (threaded)
- Victaulic 722 (threaded)
- Anvil Fig 171N (threaded)

.12 Double regulating valves (DRV), NPS 2 and under, threaded

.1 1000 kPa (150 psi) Copper alloy body, plug type stem with flow measurement ports and tamper- proof setting.

Standard of Acceptance
- S.A. Armstong CBV
- Tour & Anderson STAD
- Newman Hattersley #1700
- Preso B-PLUS

.13 Double regulating valves (DRV), NPS 2½ and over, flanged

.1 860 psi (125 psi), cast or ductile iron body, raised face flanges, copper alloy trim, with flow measurement ports, tamper-proof setting.

Standard of Acceptance
- S.A. Armstrong CBV II
- Tour & Anderson series 787
- Newman Hattersley #737
- Preso B-PLUS

2.4 Heating and cooling water valves

.1 Gate valves NPS 2 and under, threaded

.1 1000 kPa (150 psi) to 2000 kPa (300 psi) rising stem, 800 pound forged steel body, solid wedge disc, bolted bonnet.

Standard of Acceptance
- Bonney Forge HL-11-T
- Crane B-3604XUT
- Newman Hattersley #C1174

.2 1000 kPa (150 psi) to 2000 kPa (300 psi) rising stem to MSS SP-80, Class 300, with bronze body, copper nickel alloy trim, solid wedge disc, and union bonnet

Standard of Acceptance
- Kitz 37
- Crane 636E
- Jenkins 2282J
- Nibco T-174-SS

.2 Gate valves NPS 2½ and over, flanged

.1 1000 kPa (150 psi) to 2000 kPa (300 psi), rising stem, to ASTM A216 Gr WCB, Class 300 with raised face flanges, cast steel body, flexible disc, 13% chrome to stellite trim, OS & Y bolted bonnet.

Standard of Acceptance
- Kitz 300 SCLS
- Crane 33XU-F
- Jenkins J1010B8F
- Newman Hattersley #C1482

.3 Globe valves NPS 2 and under, threaded

.1 1000 kPa (150 psi) and 2000 kPa (300 psi) to MSS SP-80, Class 300 with bronze body, hardened stainless steel plug, renewable seat and union bonnet.

Standard of Acceptance
- Kitz 17S
- Crane 382P
- Jenkins 592J
- Newman Hattersley #23
- Nibco T-276-AP

.2 1000 kPa (150 psi) to 2000 kPa (300 psi) threaded, 800 pound forged steel body, bolted bonnet, hard faced disc and seat ring.

Standard of Acceptance
- Bonney Forge HL-31-T
- Crane B-3644XU-T
- Newman Hattersley #C1874

.4 Globe valves NPS 2½ and over, flanged

.1 1000 kPa (150 psi) to ASTM A216 Gr WCB, Class 300, cast steel body, 13% chrome to stellite trim, OS & Y and bolted bonnet.

Standard of Acceptance
- Kitz 300SCJS
- Crane 151XU
- Jenkins J104B2
- Newman Hattersley #C1882

.5 Ball valves NPS 2 and under, soldered

.1 1000 kPa (150 psi) Class 150, full port, two piece bronze body, stainless steel or chrome plated bronze ball, PTFE seat and seals.

.2 handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

Standard of Acceptance
- Kitz 59
- Crane 9322
- Jenkins 202J
- Newman Hattersley #1999
- Nibco S-FP-600
- Watts

.6 Ball valves NPS 2 and under, threaded

.1 1000 kPa (150 psi) Class 150, full port, two piece bronze body, chrome plated bronze ball, PTFE seat and seals.

.2 handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

Standard of Acceptance
- Kitz 58
- Crane 9302
- Jenkins 201J
- Newman Hattersley #1969F
- Nibco T-FP-600
- Victaulic 722
- Anvil Fig 171N

.7 Butterfly valves NPS 2½ to 12, for grooved end pipe:

.1 1000 kPa (150 psi) Class 150, long neck design malleable or ductile iron body, EPDM Grade "E" dual seal coated disc for 93°C (230°F) working temperature, lever operator to NPS 4, gear operator NPS 6 to 12

Standard of Acceptance
- Victaulic Series 300
- Nibco GD-4765
- Mueller 59G

.8 Butterfly valves NPS 2½ and over, flanged

.1 1000 kPa (150 psi) to MSS-SP-67, cast iron lug body style with holes drilled and tapped; (a) stainless steel shaft, bronze or cast iron disc with nickel chrome seating edge and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.
(b) with locking handles up to NPS 4 and gear operators for NPS 6 and over.

Standard of Acceptance
- Crane Center Line series 200
- Kitz 6122E
- Colton CILB Series
- Nibco LD-3010
- Challenger #20CN4E
- DeZurik BOS
- Watts BF
- SureSeal 600

.2 High performance type for working pressures over 1000 kPa (150 psi), ANSI B16.34 temperature and pressure rated carbon steel lug body with holes drilled and tapped.

(a) 316 or 17-4 stainless steel disc and shaft, Teflon seat complete with titanium or 316 stainless steel spiral wound back-up ring to provide bubble tight shut-off under system pressure from either side, when installed with single flange.
(b) with locking handles up to NPS 4 and gear operators for NPS 6 and over.
(c) ANSI 300 temperature and pressure rated and suitable for working pressures 1964 kPa (285 Psi) to 4823 kPa (740 psi) at 37.8°C (100°F), factory tested to minimum of 4823 kPa (740 psi) at 37.8°C (100°F)

Standard of Acceptance
- Crane Flowseal

- DeZurik BHP Series
- Keystone K-Lok Series
- Mueller
- SureSeal

.9 Swing check valves NPS 2 and under, soldered

.1 1000 kPa (150 psi) to MSS SP-80, Class 125, bronze body, bronze swing disc, screw in cap, regrindable seat.

Standard of Acceptance
- Kitz 23
- Crane 1342
- Jenkins 4093J
- Newman Hattersley #47 with NPT copper adaptors
- Nibco S-413-B

.10 Swing check valves NPS 2 and under, threaded

.1 1000 kPa (150 psi) to MSS SP-80, Class 125, bronze body, bronze swing disc, screw in cap, regrindable seat.

Standard of Acceptance
- Kitz 22
- Crane 37
- Jenkins 4037J
- Newman Hattersley #47
- Nibco T-143-B

.2 1000 kPa (150 psi) and 2000 kPa (300 psi) to MSS SP-80, Class 300, bronze body, bronze swing disc, screw in cap, regrindable seat

Standard of Acceptance.
- Kitz 19
- Crane 76E
- Jenkins 4962J
- Nibco T-473-B

.11 Swing check valves NPS 2½ and over, flanged

.1 1000 kPa (150 psi) to MSS SP-71, Class 125, cast iron body, flat faced flange, renewable bronze seat ring, bronze disc, bolted cap.

Standard of Acceptance
- Kitz 78
- Crane 373
- Jenkins 587J
- Newman Hattersley #651
- Nibco F-918-B
- Valmatic Series 500 Swing Flex

.2 1000 kPa (150 psi) and 2000 kPa (300 psi) to ASTM A216 Gr WCB, Class 300, cast steel body, renewable stainless steel seat ring, stainless steel disc, bolted cap.

Standard of Acceptance
- Kitz 300 SCOS

- Crane 159XU
- Newman Hattersley #C1982

.12 Silent check valves NPS 2 and under, threaded

.1 1000 kPa (150 psi) Class 125, cast iron or bronze body, globe style, (non flapper), bronze trim, stainless steel spring.

Standard of Acceptance
- APCO 300 Series
- Durabla SCV
- Nibco T-480
- Kitz 36/26
- Valmatic

.13 Silent check valves NPS 2½ and over, flanged

.1 Class 125, cast iron body globe style, bronze trim, stainless steel spring

Standard of Acceptance
- APCO 600 Series
- Valmatic series 1800
- Durabla GLC
- Mueller 105 MAP
- Nibco F-910

.14 Silent check valves NPS 2, for grooved end pipe

.1 300 pound design, ductile iron body, stainless steel clapper, Grade E EPDM liner, suitable for 93ºC (230ºF) operating temperature.

Standard of Acceptance
- Victaulic 712
- Gruvlok 7800
- Valmatic

.15 Silent check valves NPS 2½ and over, for grooved end pipe

.1 300 pound design, ductile iron body, ductile iron or bronze disc, nickel seat, EPDM liner, suitable for 93ºC (230ºF) operating temperature

Standard of Acceptance
- Victaulic 716
- Gruvlok GBV

.16 Double regulating valves (DRV), NPS 2 and under, threaded

.1 1000 kPa (150 psi) Copper alloy body, plug type stem with flow measurement ports and tamper- proof setting.

Standard of Acceptance
- S.A. Armstong CBV
- Tour & Anderson series 787
- Newman Hattersley #1700
- Preso B-PLUS

.17 Double regulating valves (DRV), NPS 2½ and over, flanged

.1 860 psi (125 psi), cast or ductile iron body, copper alloy trim, with flow measurement ports, tamper-proof setting.

Standard of Acceptance
- S.A. Armstrong CBV II
- Tour & Anderson STAF
- Newman Hattersley #737
- Preso B-PLUS

3 EXECUTION

3.1 Valve installation

.1 Install shut off valves at:

.1 branch take-offs,

.2 to isolate piping to each piece of equipment, and

.3 in locations shown.

.2 Install valves in upright position with stem above horizontal

.3 Remove internal parts of valves before soldering, welding or brazing pipe to valve body.

.4 Arrange valve hand wheels and operating levers to be accessible

.5 In equipment rooms and service spaces provide chain operators for valves mounted more than 2m (6 ft) above floor or access platform. Chains to extend to 1.5m (4 ft-6 in) above floor or platform and to be hooked on clips secured to building structure, clear of walking aisles.

.6 Install double regulating valves with five pipe diameters of straight pipe on inlet side and two pipe diameters on outlet side.

.7 Install triple duty or throttling valves where shown in pump discharge piping with ten pipe diameters of straight pipe on the inlet side and two pipe diameters on outlet side.

.8 Supply one flow meter for double regulating and triple duty valves and turn over to operating staff during operations and maintenance training. Obtained signed receipt showing time, date, and name of recipient.

.9 Install butterfly valves between weldneck flanges

3.2 Double regulating valves

.1 Consult with double regulating valve manufacturer to ensure correct valve selection. Balancing valves to be sized according to design flow

.2 Size and select valves for flows as shown at 6 kPa (2 ft) pressure drop across the valve in the fully open position, and in accordance with manufactures recommendation. Table 1 identifies the nominal valve size selection:

Valve Size (in)	Nominal Flow			
	Min. (l/s)	Max. (l/s)	Min. (gpm)	Max. (gpm)
½	0.038	0.177	0.6	2.8

¾	0.126	0.379	2.0	6.0
1	0.246	0.631	3.9	10.0
1¼	0.316	0.947	5.0	15.0
1½	0.416	1.262	6.6	20.0
2	0.795	2.272	12.6	36.0
2½	2.398	6.310	38.0	100.0
3	1.956	8.203	31.0	130.0
4	4.291	12.620	68.0	200.0
5	5.679	20.192	90.0	320.0
6	11.48	28.395	182.0	450.0
8	23.16	51.742	367.0	820.0
10	34.07	82.030	540.0	1300.0
12	60.58	94.650	960.0	1500.0

.3 Install double regulating valves with five pipe diameters of straight pipe on inlet side, two pipe diameters on outlet side and 10 pipe diameters from any pump.

END OF SECTION

WELDING
20 05 24

1 GENERAL

1.1 Scope

.1 Weld or braze pipe and fittings for work of Division 20.

.2 In this section, the term “weld, welder, welding” or similar word or phrase is an expression which includes both welding or brazing.

1.2 Registration and Inspection

.1 Before commencing work, make arrangements and pay for registration and inspection by Technical Standards & Safety Authority (TSSA), for the following pressure piping systems:

.1 steam, including condensate piping, at pressures over 100 kPa (15 psig),

.2 compressed air, greater than NPS 3/4, at pressures over 100 kPa (15 psig),

.3 service water piping for building hot water heating systems, at design temperatures above 121°C (250°F) or at design pressures above 1070 kPa (160 psig),

.4 chilled water, cooling water, and process water systems, for liquids no more hazardous than water, at design temperatures above 65°C (150°F) or design pressures above 1717 kPa (250 psig), and

.5 medical gas and laboratory gas systems.

1.3 Applicable standards:

.1 O.Reg. 220/01 made under the TSSA Act

.2 CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code

.3 CSA B52 Mechanical Refrigeration Code

.4 Piping standards to:

.1 ASME B31.9 Code for Building Service Piping.

.5 ASME Boiler and Pressure Vessel Code, Section VIII Division 1

.6 ASME Boiler and Pressure Vessel Code, Section IX

2 PRODUCTS

2.1 Not used

3 EXECUTION

3.1 Welder qualification and welding procedures

.1 Welding of piping carrying steam, condensate, hot water, chilled water, or compressed air, at pressures greater than 100 kPa (15 psi) to be carried out using approved procedures by welders certified for pressure piping by TSSA.

.2 Welding, both shop and field, to be electric arc in accordance with recommendations of Canadian Welding Bureau.

.3 Welders Certificates and Welding Procedures used on job to be available for inspection during pipe welding operations. Each weld to be stamped with welder's identifying number.

3.2 Welded connections to existing pressure piping systems

.1 At the commencement of the Work, review with authority-having-jurisdiction inspector to determine their weld testing requirements to validate the proposed welding procedures, including but not limited to:

.1 dimensional misalignment between old and new pipe,

.2 metallurgical analysis of exiting piping,

.3 guided bent test, and

.4 fillet weld test.

.2 After testing requirements are determined, provide a proposed schedule for tie-in connections and required existing service shut-down periods, for approval prior to commencing work.

3.3 Weld Quality

.1 Welds to be solid homogeneous part of metals joined and free from pits and incorporated slag and scale.

.2 Weld surfaces to be smooth and regular and weld metal deposition to achieve full penetration with groove filled with weld metal, fused to the base metal throughout joint thickness.

.3 Conduct visual examination of welds in accordance with the applicable piping standard and submit copy of examination report for review. For registered pressure piping systems, include copies of field inspection reports.

END OF SECTION

HANGERS AND SUPPORTS
20 05 29

1 GENERAL

1.1 Scope

.1 Provide hangers and supports for piping and conduits.

1.3 Related Work

.1 Ductwork hangers: to section 23 31 13

1.4 Shop drawings

.1 Product data to show:
- .1 upper attachment.
- .2 hanger rods.
- .3 pipe attachment.
- .4 riser clamps.
- .5 shields and saddles.
- .6 inserts.

.2 Submit details for supports, guides, and anchors for glass, fibre-reinforced plastic, and plastic piping systems.

.3 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.
- .1 Shop drawing details:
  - (a) construction detail drawings for each loading condition,
  - (b) span deflection calculations,
  - (c) building attachment load calculations and type.
- .2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

1.5 Applicable Codes and Standards;

.1 ASME B31.9 Building Service Piping

.2 Manufacturers Standardization Society of Valve 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-77 Guidelines for Pipe Support Contractual Relationships
- .4 MSS SP-90 Guidelines for Terminology for Pipe Hangers and Supports

.3 The Ontario Building Code

2 PRODUCTS

2.1 General

.1 Hangers, supports, sway braces, to be made up from stock or production parts, manufactured and fabricated in accordance with ASME B31.1 and MSS SP-58, SP-69, and SP-90.

.2 Select elements of pipe support systems to provide adequate factors of safety under loads applied by gravity, by temperature induced expansion and contraction, by internal pressure in mechanically jointed plain end pipe, by change of momentum in fluid flow.

2.2 Product identification

.1 Pipe support products to be selected from manufacturers standard product line

Standard of Acceptance
- Anvil
- Unistrut
- Myatt
- Hunt Erico
- Taylor
- National Concrete Accessories - Acrow Richmond
- Pipe Shields
- Portable Pipe Hangers
- Hilti

.2 Model designations from these manufacturer's catalogue are used to establish quality standards and construction details to permit assessment of products from other manufacturers.

2.3 Upper attachments

.1 Cast-in-place concrete:

.1 single or double pipe runs up to and including 300 mm (12 in)

diameter: (a) galvanized wedge inserts to MSS SP-58, type 18.
(b) ULC listed for pipe NPS ¾ through NPS 8.

Standard of Acceptance
- Anvil - Model 281
- Unistrut - Model P-3245

.2 pipe runs of three or more pipes:

(a) multiple inserts, spaced to suit smallest pipe in group.

Standard of Acceptance
- Unistrut of Canada Limited

.2 Surface mount on concrete:

.1 carbon steel plate with clevis and malleable iron socket and expansion case and bolt with minimum of two expansion cases and bolts for each hanger.

Standard of Acceptance
- Anvil plate, Fig. 49 socket, Fig. 290 expansion case, Fig. 117

- Myatt cut plate, double angle clip, Fig. 535 socket, Fig. 480 expansion case, Fig. 485 for existing concrete

.2 Do not use explosive drive pins in any section of Work without obtaining prior approval.

.3 Piping or equipment supported from existing concrete construction:

.1 drill and install threaded inserts.

Standard of Acceptance
- Hilti - HDI, Kwick Bolt, HSL

.4 Steel framed construction:

.1 steel beam (bottom flange) and cold piping NPS 2 and under: (a) beam clamp to MSS SP-58, type 30, ULC listed.

Standard of Acceptance
- Anvil Fig. 218
- Myatt Fig. 500

.2 steel beam (bottom flange) and cold piping NPS 2½ and larger and hot piping: (a) heavy beam clamp assembly to MSS SP-58, type 28 or 29, or (b) fabricated equivalent, ULC listed.

Standard of Acceptance
- Anvil Fig. 228 or 292
- Myatt Fig. 510 X-HEAVY, or 511 X-HEAVY.

.3 steel beam (top flange) and cold piping and hot piping NPS 2 and under:

(a) steel jaw, hook rod with nut, spring washer and plain washer, to MSS SP-58, type 25, ULC listed.

Standard of Acceptance
- Anvil Fig. 227
- Myatt Fig. 506

.4 steel joists and cold piping NPS 2 and under:

(a) steel washer plate with double locking nuts.

Standard of Acceptance
- Anvil Fig. 60
- Myatt Fig. 545

.5 steel joists and cold piping NPS 2½ and larger and hot piping:

(a) steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

Standard of Acceptance
- Anvil washer plate - Fig. 60, clevis - Fig. 66, socket - Fig. 290.
- Myatt washer plate - Fig. 545, clevis - Fig. 530, socket - Fig. 480.

2.4 Hanger rod

.1 Carbon steel threaded rod;

.1 electro-galvanized finish in mechanical rooms and outdoors.

.2 black steel finish in other areas.

Standard of Acceptance
- Anvil Fig. 146
- Myatt Fig. 432

2.5 Horizontal pipe support - suspended

.1 Hot or cold suspended piping, including conduits, where horizontal movement is 25 mm (1 in) or less and hanger rod is longer than 300 mm (12 in).

.1 steel or cast iron piping:

(a) adjustable clevis to MSS SP-58, type 1, ULC listed, sized for outside dimension of pipe and insulation.

Standard of Acceptance
- Anvil Fig. 260
- Myatt Fig. 124

.2 copper piping:

(a) adjustable clevis to MSS SP-58, type 1, copper plated.

Standard of Acceptance
- Anvil Fig CT-65
- Myatt 151 CT

.2 Suspended hot steel or copper piping having horizontal movement in excess of 25 mm (1 in) or hot steel piping with hanger rod 300 mm (12 in) or less:

.1 trapeze or yoke style pipe roller to MSS SP-58, type 43.

Standard of Acceptance
- Anvil Fig. 171 or fig. 181
- Myatt Fig. 261 or fig. 258

2.6 Horizontal pipe support - bottom supported

.1 Hot and cold steel and copper piping:

.1 adjustable pipe roller stand to MSS SP-58, type 44.

Standard of Acceptance
- Anvil Fig. 177
- Myatt Fig. 262

2.7 Trapeze hangers

.1 Performance:

.1 Manufactured:

(a) to product load listings.

.2 Custom fabricated:

(a) maximum deflection between supports: 1/250 (0.4%) of span
(b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.

.2 Construction:

.1 Carbon steel shapes, to suit load application:

(a) hollow steel section,
(b) equal leg El section, or
(c) double C channel “strong-back”, with welded clips.

.2 Hanger rods:

(a) as specified above, and
(b) minimum two support rods,
(c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.

.3 Pipe restraint:

.1 restrain pipes from lateral movement with:

(a) bolt-on angle brackets or pipe U-bolts for manufactured hangers,
(b) welded-on angles for fabricated hangers.

.4 Finish:

.1 electro-galvanized finish in mechanical rooms and outdoors.

.2 black steel finish in other areas.

Standard of Acceptance
- Anvil Fig 45, 46, 50

2.8 Vertical pipe supports:

.1 Steel or cast iron pipe:

.1 floor supported, black carbon steel riser clamps to MSS SP-58, type 42, ULC listed, field-welded pipe lugs.

Standard of Acceptance
- Anvil Fig. 261
- Myatt Fig. 182 or 183

.2 suspended, black carbon steel riser clamps to MSS SP-58, type 42, ULC listed, 4 or 6 bolt pattern, field-welded pipe lugs.

Standard of Acceptance
- Anvil fig. 40
- Myatt fig. 190 or 191

.2 Copper pipe:

.1 carbon steel, copper finished, riser clamps to MSS SP-58, type 8.

Standard of Acceptance
- Anvil Fig. CT-121
- Myatt Fig. 150CT

2.9 Variable load supports

.1 Performance:

.1 Selected for piping loads and estimated travel under service conditions.

.2 Construction:

.1 carbon steel housing and spring,

.2 pre-compressed spring,

.3 load indicator,

.4 welding to ASME Section IX

.5 welded attachment points

.6 finish: semi gloss primer coat.

Standard of Acceptance
- Anvil – Fig 82, 268, 98

2.10 Constant load supports

.1 Performance:

.1 maintains constant support load under variable hanger displacements.

.2 selected for piping loads and estimated travel under service conditions, with a minimum safety factor of 25 mm (1 in) extra travel or 20% of total travel, whichever is greater.

.2 Construction:

.1 to WW-H-171E, ANSI/MSS SP-69 and 58

.2 carbon steel housing and spring,

.3 combination hanger moment arm and balancing spring design,

.4 horizontal and vertical arrangements,

.5 load adjustment and load indicator scale,

.6 factory set for load and travel,

.7 welding to ASME Section IX

.8 welded attachment points

.9 finish: semi gloss primer coat.

Standard of Acceptance
- Anvil – Fig R 80-V, 81-H

2.11 Roding for mechanical joint pipe

.1 Plain end cast iron and asbestos cement drain waste and vent pipe, NPS 5 and over,

.1 bell clamps and rodding at each joint

Standard of Acceptance
- Myatt Fig. 175 in configuration Fig. 176
- Anvil Fig. 595 with Fig. 594 washers
- Taylor Fig. 35

.2 bell clamp and rodding at each tee branch
- Myatt Fig. 175 in configuration Fig. 180
- Anvil Fig. 595 with Fig. 594 washers
- Taylor Fig. 35

2.12 Saddles and shields at pipe supports

.1 Cold piping insulation shields:

.1 provided for steel, copper, stainless, glass and plastic piping, all sizes,

.2 galvanized steel protection shield.

Standard of Acceptance
- Anvil Fig. 167 (up to NPS 24)
- Anvil Fig. 168 - Riblok (up to NPS 8)
- Myatt Fig. 251

.2 Hot piping insulation shields:

.1 provided for steel piping NPS 1-1/4 and smaller,

.2 provided for copper tubing, all sizes,

.3 galvanized steel protection shield.

Standard of Acceptance
- Anvil Fig. 167 (up to NPS 24)
- Anvil Fig. 168 - Riblok (up to NPS 8)
- Myatt Fig. 251

.3 Hot piping saddles:

.1 provided for steel piping, NPS 1½ and larger:

.2 protective saddle welded to pipe with insulation inserted between saddle and pipe.

Standard of Acceptance
- Anvil Fig. 160 to 166
- Myatt Fig. 210 to 240

3 EXECUTION

3.1 Coordination with concrete work

.1 Supply and deliver inserts to site in ample time to be built into work.

.2 Set and correctly locate inserts for pipes and equipment hangers. Secure inserts firmly to formwork before concrete is poured.

3.2 Hanger installation

.1 Support piping and conduit directly from or on structural building elements. Do not support pipe or conduit directly from other services except as described below.

.2 The hanger rod size and spacing in the following articles is based on supporting a single pipe directly from the structure.

.1 If multi-level pipe or conduit supports are proposed, such as trapeze or roller hanger supports, submit shop drawings designed and sealed by a professional engineer licensed as a consulting engineer in the province of the project location and include details for each support system including load calculations.

.2 Coordinate with the structural engineer for point load connections to the building structure.

.3 Install hangers for steel pipe with spacing and hanger rod diameter in accordance with table 1.

.1 Exception: fuel oil, natural gas, propane, and medical gas piping.

.4 Install hangers for copper pipe with spacing and hanger rod diameter in accordance with table 2.

.1 Exception: fuel oil, natural gas, propane, and medical gas piping.

.5 Install hangers for cast iron soil pipe with hanger spacing and hanger rod diameter in accordance with table 3 and as follows:

.1 provide at least one pipe hanger for each length of pipe, located at or within 300 mm (12 in) of each hub or mechanical joint,

.2 provide a hanger at or adjacent to each fitting hub or mechanical joint except where multiple joints occur within a 1200 mm (4 ft) developed pipe length then;

(a) support may be reduced to every other hub or mechanical joint, or
(b) where the pipe run is made of multiple fittings connected end-to-end, a 1.6 mm (16 ga) galvanized steel half sleeve may be used underneath the pipe and fittings and supported with a hanger at each end of the sleeve.

.3 for mechanical joints, if the spacing between adjacent joints is 300 mm (12 in) or less, reduce the support spacing to a maximum of 1000 mm (39 in),

.6 Refer to Section 23 11 23 for hanger spacing for Natural Gas and Propane Piping.

Table 1 : Hanger Spacing for Steel Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing
½	10 mm (3/8 in)	1.8 m (6 ft)
3/4 to 1¼	10 mm (3/8 in)	2.1 m (7 ft)
1½	10 mm (3/8 in)	2.7 m (9 ft)
2	10 mm (3/8 in)	3.0 m (10 ft)
2½	13 mm (½ in)	3.3 m (11 ft)
3	13 mm (½ in)	3.3 m (12 ft)
4	16 mm (5/8 in)	4.2 m (14 ft)
6	16 mm (3/4 in)	5.1 m (17 ft)
8	22 mm (3/4 in)	5.7 m (19 ft)
10	22 mm (7/8 in)	6.7 m (22 ft)
12	22 mm (7/8 in)	7.0 m (23 ft)
14	25 mm (1 in)	7.5 m (25 ft)
16	25 mm (1 in)	8.0 m (27 ft)
18	25 mm (1 in)	8.4 m (28 ft)
20	30 mm (1-1/4 in)	9.0 m (30 ft)
24	30 mm (1-1/4 in)	9.6 m (32 ft)

Table 2 : Hanger Spacing for Copper Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing (Copper)
½	10 mm (3/8 in)	1.5 m (5 ft)
3/4 to 1¼	10 mm (3/8 in)	1.8 m (6 ft)
1½	10 mm (3/8 in)	2.4 m (8 ft)
2	10 mm (3/8 in)	2.7 m (9 ft)
2½	13 mm (½ in)	3.0 m (10 ft)
3	13 mm (½ in)	3.0 m (10 ft)
4	16 mm (5/8 in)	3.0 m (10 ft)

Table 3: Hanger Spacing for Cast Iron Soil Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing (CI soil pipe)
3	13 mm (½ in)	3 m (9.8 ft)
4	16 mm (5/8 in)	3 m (9.8 ft)
6	16 mm (3/4 in)	3 m (9.8 ft)
8	22 mm (3/4 in)	3 m (9.8 ft)
10	22 mm (7/8 in)	3 m (9.8 ft}

.7 Hanger spacing and hanger rod diameter for steel or copper flexible joint roll groove pipe to be as shown in table above for appropriate pipe material with not less than one hanger between joints and with anchors and guides located to maintain piping true to line and grade.

.8 In steel framed construction, support piping from structural members. Where structural members are not suitably located for upper hanger attachments and inserts of adequate capacity cannot be installed in floor slabs over, provide supplementary steel framing members;

.1 fabricate supplementary steel from standard HSS sections, single EL section, double C “strongback” sections, or pipe rolls,

.2 size supporting steel to limit span deflection to 1/250 (0.4%) between support points,

.3 mechanically fasten supplementary steel to structural steel.

.9 Offset hangers so that rods are vertical in operating position.

.10 Provide hanger within 300 mm (12 in) of each horizontal elbow and tee.

.11 Clamp and rod tees, elbows, and joints, in plain end mechanical joint pipe NPS 5 and over.

.12 Riser clamps:

.1 Weld lugs onto steel piping.

.2 Solder copper pipe to copper riser clamps.

.13 Trapeze hangers

.1 Shim pipes on common trapeze hangers to slope each pipe in required direction.

.2 Mechanical fasten shim plates to hanger. Shim plates and pipe lateral restraints may be fastened as one unit.

3.3 Variable load supports

.1 Size, select and install variable load supports for piping in mechanical rooms at first three load points from a shaft penetration.

.2 Provide vibration isolation hangers for other locations in accordance with Section 20 05 48 Vibration Isolation.

3.4 Constant load supports

.1 Size, select and install constant load supports at the following locations;

.1 pipe risers, located at the top of the riser, and intermediate riser locations,

.2 first hanger support for main steam piping connections NPS 6 and larger to steam boilers,

.3 first hanger support for water piping connections NPS 8 and larger to hot water boilers,

.4 first hanger support for water piping connections NPS 12 and larger to refrigeration equipment

.5 first hanger support inside the building for water piping NPS 12 and larger for condenser water piping to a cooling tower.

3.5 Saddles and shields

.1 On cold insulated piping, provide insulation shields between insulation and pipe support.

.2 On hot insulated piping, weld protective saddles to pipe at pipe support locations.

.3 No saddles or shields are required on un-insulated piping.

3.6 Load nut retention requirements

.1 Adhere fastening nuts, including top and bottom load nuts, and clevis bolt nuts, to threaded rods or fittings with Loctite 266.

3.7 Set-up after installation

.1 Adjust hangers to equalize hanger loads, to support piping true to line and grade, and to minimize loads transferred through connections to equipment and outlets.

END OF SECTION

VIBRATION ISOLATION
20 05 48

1 GENERAL

1.1 Scope

.1 Isolate motor driven mechanical equipment.

.2 Provide restraints for equipment mounted on vibration isolation to limit movement during start-up and normal operation.

.3 Isolator and base type designations are taken from appropriate chapter of current ASHRAE Applications Handbook.

.4 Base type, isolator type and minimum static deflection are shown in equipment schedules and equipment selection sheets.

.5 Information shown in equipment schedules is to establish minimum standards, vibration isolation equipment to be selected to maintain noise levels in building below RC levels in following schedule.

AREA	NOISE CRITERIA (NC level)
Offices - private	32 to 34
-open plan	36 to 38
-business machine areas	40 to 42
-conference/boardrooms	30 to 32
Public Areas	38 to 40

1.2 Related Sections

.1 Pipe movement control to Section 20 05 16 Flexible Connections, Expansion Joints, Anchors & Guides

.2 Piping constant load supports to Section 20 05 29 Hangers and Supports

1.3 Shop drawings

.1 Show vibration isolation for each piece of equipment hung from the structure or supported from the floor.

.2 Submit product data sheets for isolation components.

.3 Show fabrication details, location and size of anchor bolts and requirements for inertia bases.

.4 Provide vibration isolation equipment by one manufacturer.

Standard of Acceptance

- Vibron / Kinetics
- BVA
- KorfundMason
- Tecoustics

2 PRODUCTS

2.1 Resilient isolator Type 1 (R1)

.1 Rubber waffle or ribbed pads:

.1 30 durometer natural rubber, minimum of 13 mm (½ in) thick,

.2 selected for maximum loading of 350 kPa (50 psi).

.2 Rubber-steel-rubber pads:

.1 two layers of rubber waffle or ribbed pad, 13 mm (½ in) thick, as specified above,

.2 bonded to 6 mm (¼ in) steel plate with holes sleeved and fitted with isolation washers.

.3 Neoprene jacketed pre-compressed moulded fibreglass.

2.2 Resilient isolator Type 2 (R2)

.1 Elastomer rubber:

.1 threaded insert,

.2 hold down bolts.

.2 Neoprene, 50 mm (2 in) free height:

.1 natural frequency not to exceed 15 Hz at full load,

.2 capable of sustaining load of 110 kg (250 lb) with maximum deflection of 5 mm (3/16 in).

2.3 Elastomeric mounts (E1)

.1 Construction:

.1 colour coded neoprene in shear with

.2 maximum durometer of 60,

.3 threaded insert,

.4 two bolt down holes,

.5 ribbed top and bottom surfaces.

2.4 General requirements for spring mounts

.1 Isolator springs:

.1 designed so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height,

.2 selected for 50% travel beyond rated load,

.3 cadmium plated,

.4 colour coded.

.2 Mounts:

.1 zinc or cadmium plated hardware,

.2 rubber isolation washers,

.3 housings coated with rust resistant paint,

.4 levelling devices, and

.5 6 mm (¼ in) thick ribbed rubber sound pad bonded to load plate.

.3 Clearance between metal parts: 6 mm (¼ in) minimum.

2.5 Spring isolator Type 1 (S1)

.1 Open spring isolators:

.1 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

2.6 Spring isolator Type 2 (S2)

.1 Controlled spring isolators with

.1 heavy rigid steel base frames,

.2 built-in vertical limit stops,

.3 removable spacers, and

.4 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

2.7 Spring isolator snubber Type 3 (S3)

.1 Open spring isolators:

.1 horizontal arrangement

.2 heavy rigid steel equipment base mount, and structure mount

.3 open spring, with 25 mm (1 in) deflection range.

.4 isolator bushings.

2.8 General requirements for isolation hangers

.1 General

.1 swivel arrangement to permit hanger box or rod to move through 20 arc without metal to metal contact.

2.9 Hanger Type 1 (H1)

.1 Spring hanger:

.1 welded steel housing with one coat anti-rust paint,

.2 colour coded spring,

.3 retaining cups,

.4 elastomeric washers.

2.10 Hanger Type 2 (H2)

.1 Rubber isolation hanger:

.1 welded steel housing with one coat anti-rust paint,

.2 25 mm (1 in) colour coded neoprene in shear with maximum durometer of 60,

.3 threaded insert.

2.11 Hanger Type 3 (H3)

.1 Horizontal thrust restraint:

.1 spring and elastomeric element

.2 housed in box frame with rods and angle brackets to connect unit between isolated equipment and fixed object, and

.3 fitted with means to adjust maximum start-stop movement to 9 mm (⅜ in).

2.12 Acoustic barriers for anchors and guides

.1 Manufactured from 25 mm (1 in) thick neoprene isolation with duck reinforcing material.

2.13 Equipment base Type A

.1 Direct isolation:

.1 used where equipment is unitary and rigid

.2 motor slide rails welded to unit.

2.14 Equipment base Type B

.1 Prefabricated steel base:

.1 welded from structural sections and

.2 reinforced for drive with;

(a) isolation elements attached to base brackets and
(b) adjustable motor slide rails.

.3 minimum vertical section of base selected on basis of motor size from following;

Motor Size Horsepower	Motor Size kW	Vertical Side mm (in)
up to 3	up to 2.2	75 (3)
7.5	5.5	100 (4)
20	15	150 (6)
50	37	200 (8)
over 50	37	250 (10)

2.15 Equipment base Type C

.1 Concrete filled inertia base:

.1 Type B base and,

.2 full depth perimeter structural section or formed plate channel frame

with; (a) welded in place reinforcing rods running in both directions and
(b) 1 mm (20 ga) metal pans,

(c) base section filled with concrete, vibrated into place.

.3 spring mount units carried by gusseted brackets welded to frame and

.4 'T' shaped bases to support pump elbows.

2.16 Base Type D

.1 Roof curb isolation rails:

.1 manufactured with structural steel or aluminum upper and lower members, with

(a) continuous flexible reinforced water and air tight seal fastened to upper and lower members,

.2 protected by removable metal weather shield.

.3 supported from lower members by stable steel springs, with

.4 maximum deflection 50 mm (2 in) and

.5 closed cell neoprene gaskets.

.6 constructed with neoprene cushioned restraints to resist wind load in any direction.

3 EXECUTION

3.1 General

.1 Install vibration isolation equipment in accordance with manufacturer's instructions and locate isolation for equipment to provide stable support under saddles, frames and projections of equipment.

3.2 Equipment vibration isolation

.1 Provide additional steel in bases and rails to obtain rigidity and uniform load distribution.

.2 Suspended fans and fan powered boxes to be supported on

.1 Type A or B base with

.2 Type H3 hangers.

.3 Rooftop units to be supported on

.1 Type D base

.4 Block and shim bases level at correct operating height.

.1 Bases to clear housekeeping pads by:

(a) 25 mm (1 in) minimum for concrete and
(b) 50 mm (2 in) minimum for steel.

.5 Where isolation is bolted to floor, housekeeping slab or overhead structure:

.1 provide vibration isolation rubber washers.

.6 Where ducts attach to resiliently mounted equipment, flexible connections will be provided by ductwork installer.

3.3 Service connection vibration isolation

.1 Make pipe, duct and electrical connections to isolated equipment so as to maintain isolation system flexibility.

3.4 Piping vibration isolation

.1 Piping connected to isolated equipment:

.1 supported with;

(a) spring mounts or spring hangers with static deflection of twice deflection of isolated equipment at first point of support and
(b) 25 mm (1 in) minimum static deflection at remaining supports.

.2 installed with distance between support points selected as for regular pipe hangers and using spring type for

(a) first three supports for piping up to NPS 4.

.3 Isolated, with acoustic barrier material, at anchors and guides within pipe shafts, duct shafts, equipment and fan rooms, and up to first anchor outside these rooms or areas.

.2 Where piping crosses building expansion joint

.1 provide spring hangers at first two support locations of piping at either side of joint line.

3.5 Start-up and set-up

.1 After installation of connections to resiliently mounted equipment;

.1 remove shims and blocking and adjust mountings to level equipment,

.2 adjust connections, hangers, snubbers, and restraints,

.3 ensure that there is no physical contact between isolated equipment and building structure.

.2 On completion of installation and start-up of equipment;

.1 make arrangements for manufacturer/supplier of Vibration Isolation equipment to visit site, check performance of systems, inspect installation, adjust seismic restraints, and submit written recommendations,

.2 make corrections to installation in accordance with manufacturer/suppliers recommendations,

.3 provide notice 24 hours in advance of this site visit.

3.6 Testing

.1 Engage and pay for an experienced sound and vibration professional to take measurements of sound and vibration generated by HVAC systems.

.2 Co-operate with manufacturer/supplier of Sound Attenuation equipment in this measurement and testing.

.3 Sound measurements to extend over full audio frequency range and to be taken in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and main electrical rooms.

.4 Submit outline of tests to be performed, details of instrumentation to be used and floor plans showing test locations prior to commencing work.

.5 Provide notice one week in advance of commencement of tests.

.6 Submit complete report of tests addressing noise and vibration levels measured in occupied areas and adequacy of Sound Attenuation and Vibration Isolation equipment.

END OF SECTION

IDENTIFICATION
20 05 53

1 GENERAL

1.1 Scope

.1 Provide equipment nameplates, piping and duct identification, and valve tags.

1.2 Shop Drawings

.1 Submit list of nameplates, with proposed wording, prior to engraving.

.2 Submit sample board with pipe and duct identification materials.

1.3 Applicable Codes and Standards

.1 Medical gas pipe marking: to CSA Z7396.1

2 PRODUCTS

2.1 General

.1 Manufactured identification systems:

.1 laminated vinyl or polyester,

.2 resistant to chemical, ultraviolet,

.3 minimum operating temperature: -25°C (-12°F)

.4 maximum operating temperature: 121°C (250°F)

Standard of Acceptance

- Brady - identification tapes, bands, and markers.
- Seton - Setmark Pipe Markers.
- Smillie McAdams Summerlin.
- Craftmark Identification Systems.

2.2 Equipment Identification Nameplates

.1 Identification plates are in addition to manufacturers plates.

.2 Identification plates:

.1 provided for equipment identified with number designations in schedules and equipment selection sheets.

.2 marked with equipment ID, service and power source using wording and numbering used in contract documents.

.3 Fabrication:

.1 laminated plastic,

.2 black lettering on white background for “Normal” power equipment

.3 white lettering on red background for “Emergency” power equipment

.4 minimum size 90 mm x 40 mm x 2.5 mm (3 in x 1½ in x ⅛ in),

.5 engraved with 10 mm (⅜ in) high lettering.

2.3 Piping Identification

.1 Flexible coil-wrap manufactured markers:

.1 plastic coated markers with integral printing, or plastic cover with field applied self-adhesive markers,

.2 applicable WHIMS pictogram for identification of material hazard.

.2 Self-adhesive manufactured pipe markers and colour bands:

.1 50 mm (2 in) wide tape wrapped around pipe or covering with ends overlapping one pipe diameter but not less than 25mm (1 in) for colour bands,

.2 minimum 20 mm (¾ in) high lettering,

.3 colour band tape with flow direction arrows,

.4 waterproof and heat resistant plastic marker tags for pipes and tubing 20 mm (¾ in) nominal and smaller.

.5 applicable WHIMS pictogram for identification of material hazard.

2.4 Buried Piping

.1 Materials:

.1 Stretchable polyethylene or mellized ribbon, labeled with name of service, at maximum 800 mm intervals.

2.5 Ductwork Identification

.1 Paint stencilled letters 25mm (1 in) high showing;

.1 duct service,

.2 fan number, and

.3 arrows showing direction of flow,

2.6 Valve and Steam Trap Identification

.1 Brass valve tags or plastic lamacoid:

.1 brass with stamped numbers and letters filled with black enamel,

.2 plastic lamacoid with black lettering on a white background,

.3 brass or stainless steel chain or S-hook,

3 EXECUTION

3.1 Equipment Identification

.1 Locate nameplates to be easily read.

.2 Do not paint over equipment manufacturer or field installed nameplates.

.3 Fasten securely with mechanical fasteners.

.4 Provide standoffs on insulated equipment.

.5 Examples:

.1 at equipment (fan, pump, etc.):

F-1 Auditorium Supply Fan

.2 at motor starter, adjustable frequency drive, and separate local disconnect:

P-3 Condenser Water Pump Fed from PDP-12-1

3.2 Piping Identification - Except for Non-Medical Gas Systems

.1 Provide manufactured tape markers:

.1 self-adhesive type:

(a) indoor uninsulated piping,
(b) indoor insulated piping with PVC or smooth metal jackets,

.2 flexible coil-wrap:

(a) outdoor piping,
(b) indoor insulated piping with canvas or embossed metal jackets.

.3 Install markers on cleaned and prepared surfaces free of dirt and oil.

.2 Locations:

.1 maximum every 15 m (50 ft) along length of pipe, except for medical gas, natural gas and fuel oil,

.2 maximum every 6 m (20 ft) along length of pipe for natural gas and fuel oil,

.3 within 1 m (3 ft) of each side of barriers, floors and walls,

.4 within 1 m (3 ft) of and behind access doors ,

.5 within 1 m (3 ft) of piping termination point.

3.3 Piping Identification - Buried Piping

.1 Provide tracer tape along entire length of pipe at a depth of:

.1 600 mm (2 ft) mm below top of grade for water piping,

.2 150 mm (6 in) above top of natural gas, propane, or fuel oil piping, and medical gas piping.

.2 This tape is in addition to any required electrical tracing wire that may be required under other sections.

3.4 Ductwork identification

.1 Paint stencilled letters 25mm (1 in) high showing;

.1 duct service,

.2 fan number, and

.3 arrows showing direction of flow,

.2 Locations:

.1 exposed ducts,

.2 concealed ducts next to access doors, and

.3 throughout length of ducts at intervals not exceeding 15 m (50 ft).

.3 Stencil indication on prepared surfaces, and locate on both sides of any penetration.

3.5 Valve Identification

.1 Provide every valve on job with a numbered tag showing valve type and size, attached to valve stem or wheel handle with non-ferrous chain or S-hook.

.1 Valve identification is not required at the following valves:

(a) radiation heating units, unit heaters, or fixture stops,
(b) within site of equipment or apparatus they control provided there is no branch piping between valve and equipment served.

.2 Identification information:

.1 indicating service, sequential valve number by service or specific equipment ID for control valves, location identifier, purpose of valve, valve type and size.

.2 valve type designation:

(a) B (ball valve), GT (gate valve), GL (globe valve), CBV (circuit balancing valve), BF (butterfly valve).

.3 valve size:

Domestic Cold Water #12 Riser C-1 Service Valve - B2

(a) for valve size, use NPS designation.

.4 examples:

(a) domestic cold water riser isolating valve, sequence number 12, located near column C-1, NPS 2 ball valve:

(b) hot water terminal reheat supply valve, sequence number 57, located in a corridor and not in site of equipment served, circuit balancing valve NPS 3/4:

Reheat Supply #57 Room 2-254 Balancing Valve - CBV ¾

(c) automatic control valve used for pressure balancing the system, with an equipment schedule ID of CV-15, and is globe style NPS 3:

Constant Pressure Differential Valve CV-15 Automatic Control Valve - GL 3

.3 Provide a tag schedule for each system, designating number, service, function, size, and location of each tagged item and normal operating position of each valve.

.4 Submit two copies of valve tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210 mm x 297 mm (8½ in x 11 in) three ring binders.

.5 Prepare flow diagrams for each system showing pumps, heat transfer equipment, schematic piping and tagged valves.

3.6 Steam Trap Identification

.1 Provide every trap on job with an identifying tag, attached to trap with non-ferrous chain or S-hook.

.2 Identification information:

.1 indicating service, sequential trap number by service, trap type and size.

.2 trap type designation:

(a) B (bucket), F&T (float and thermostatic), TH (thermostatic), TD (thermodynamic), BF (butterfly valve).

.3 trap size:

(a) use NPS designation.

.4 examples:

(a) 700 kPa steam system, trap # 23, bucket style, NPS 2 size.

S-700-23 B2

.3 Include trap tag schedule for each system, designating number, type, function, location, size, selection pressure differential, capacity at selected differential, manufacturer and model number of each trap, and identifying numbers of associated traps in bank where redundant trapping is provided.

.4 Submit two copies of trap tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210 mm x 297 mm (8½ in x 11 in) three ring binders.

3.7 Pipe and Valve Identification Classification

.1 Colour coding and service identifiers to be in accordance with CGSB-24.3-92 Identification of Piping Systems.

.1 Use colour coding system schedule as follows:

Primary Classification	Secondary Classification	Legend Type and Direction Arrows
Yellow 505-101	Orange 508-102	Black 512-101
Green 503-107	Purple 511-101	White 513-101
Blue 202-101	Black 512-101	
Red 509-102	Yellow 505-101	
White 513-101		

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Legend Colour
Raw Water	RAW	Low	Green	White
River Water	RIV.W	Low	Green	White
Sea Water	SEA W	Low	Green	White
City Water	CI.W	Low	Green	White
Cold Water	C.W.	Low	Green	White
Distilled Water	DI.W	Low	Green	White
Demineralized Water	DE.W	Low	Green	White
Condenser Water Supply	COND.W.S.	Low	Green	White
Condenser Water Return	COND.W.R.	Low	Green	White
Chilled Water Supply	CH.W.S.	Low	Green	White
Chilled Water Return	CH.W.R.	Low	Green	White
Chilled Water	CH.W.	Low	Green	White
Domestic Cold Water Supply	D.W.S.	Low	Green	White
Dom Hot Water Supply	D.H.W.S.	Low	Green	White
Dom Hot Water Recirc	D.H.W.R.	Low	Green	White
Hot Water Heating Supply (up to 120C)	H.W.H.S.	Hazardous	Yellow	Black
Hot Water Heating Return (up to 120C)	H.W.H.R	Hazardous	Yellow	Black
High Temp Hot Water Heating Supply (above 120C)	H.T.W.S.	Hazardous	Yellow	Black
High Temp Hot Water Heating Return (above 120C)	H.T.W.R	Hazardous	Yellow	Black
Make-up Water	M.U.W.	Low	Green	White

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Legend Colour
Boiler Feed Water	B.F.W.	Hazardous	Yellow	Black
Condensate Return - Gravity	C.R.G	Hazardous	Yellow	Black
Condensate Return - Pumped	C.R.P.	Hazardous	Yellow	Black
Blow Off	B.O.	Hazardous	Yellow	Black
Treated Water	T.W.	Low	Green	White
Brine	B.	Low	Green	White
Waste Water	W.W.	Low	Green	White
Storm Sewer	S.S.	Low	Green	White
Sanitary Sewer	SAN.S.	Low	Green	White
Combination Sanitary Storm Sewer	C.S.S.S.	Low	Green	White
Acid Drain	A.D.	Hazardous	Yellow	Black
Isotope Drain	I.D.	Hazardous	Yellow	Purple
Refrigerant Suction (include refrigerant No.)	REF.S. (No.)	Hazardous	Yellow	Black
Engine Exhaust	E.E.	Hazardous	Yellow	Black
Fuel Oil (show type No.)	F.P. (No.)	Hazardous	Yellow	Black
Steam (indicate pressure)	S. kPa (psig)	Hazardous	Yellow	Black
Lube Oil	L.O.	Hazardous	Yellow	Black
Hydraulic Oil	H.O.	Hazardous	Yellow	Black
Instrument Air	I.A.	Hazardous	Green	White
Gasoline	G.	Hazardous	Yellow	Black
L.P. Gas	L.P.G.	Hazardous	Yellow	Black
Natural Gas	N.G.	Hazardous	Yellow	Black
Chlorine	CHLOR.	Hazardous	Yellow	Black
Nitrogen Pressure 700 kPa and lower	NIT.	Low	Green	White

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Legend Colour
Oxygen (not med gas)	OXY.	Hazardous	Yellow	Black
Vacuum (not med gas)	VAC.	Low	Green	White
Compressed Air - indicate pressure (700 kPag and lower)	C.A. kPa	Low	Green	White
Compressed Air - indicate pressure (over 700 kPag)	C.A. kPa	Hazardous	Yellow	Black
Fire Protection Water	F.P.W.	Fire Protection	Red	White
Sprinkler Water	S.W.	Fire Protection	Red	White
Carbon Dioxide (fire protection)	CO	Fire Protection	Red	White
Vent (plumbing)	V.P.	Low	Green	White
Vent	V.	Hazardous	Yellow	Black

END OF SECTION

DUCTWORK INSULATION
20 07 16

1 GENERAL

1.1 Scope

.1 Insulate and finish ducts, casing, and plenums;

.1 provide insulation, sealer coatings, finishes, and mechanical protection.

.2 insulation is not required on factory insulated and/or and acoustically lined ductwork except as otherwise shown.

1.2 Quality

.1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics may be acceptable but must be submitted as an alternative product submission.

1.3 Qualifications

.1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

Standard of Acceptance
- Custom Insulation Systems
- Guaranteed Insulation Ltd
- White & Greer Co Ltd
- Dewpoint Insulation Systems

1.4 Sample Boards

.1 Submit sample assembly of each type of insulation and covering. Mount samples on PVC coroplast board with typewritten label beneath each sample indicating service and material specification.

.2 Include samples of vapor barrier installation including coatings (indoors), mastics (outdoors), reinforcing membranes, on a square surface sample minimum 300 mm x 300 mm (12 in x 12 in).

1.5 Material test criteria

.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:

.1 maximum flame spread rating of 25 to CAN/ULC-S102,

.2 maximum smoke developed rating of 50 to CAN/ULC-S102.

.3 Exception: vapor barrier mastics installed outside of building.

1.6 Applicable codes and standards

.1 Material and method of application to comply with or be tested in accordance with following Standards;

.1 Thermal Insulation Association of Canada (TIAC) National Insulation Standard, excluding section 12

.2 NFPA 90-A Installation of Air-Conditioning and Ventilating Systems

.3 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

.4 NFPA 255 Test of Surface Burning Characteristics of Building Materials

.5 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies

.6 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation

.7 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus

.8 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

.9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

.10 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation

.11 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.12 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.13 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation

.14 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.

.15 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

1.7 Definitions

.1 In this Section;

.1 “Ambient”: as applied to temperatures means outdoor design temperature.

.2 "Concealed": as applied to mechanical services and equipment located in space above opaque suspended ceilings, and within trenches not in boiler rooms, pipe and/or duct shafts, and non- accessible chases and furred spaces.

.3 “Ductwork”: as applied to this section includes ducts, fans, supply unit casings, and plenums.

.4 "Exposed": as applied to remainder of mechanical services and equipment which are not "concealed" as defined above. For greater certainty, the following locations are Exposed:

(a) Services in tunnels,
(b) Services in space beneath raised floors,
(c) Trenches located in boiler rooms,
(d) Outdoors.

.5 “Conditioned air”: air supplied from air handling units which heats, cools, dehumidifies, or humidifies the air.

.6 “Unconditioned space”: rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system

.7 “Outdoor”: mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.

.8 “Mastic”: heavy-consistency waterproof compound for outdoor applications used in

conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.

.9 "Coating": light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.

.10 "Finish Jacket": final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films; that provides weather-protective finish depending on application.

.11 "Service temperature": for purpose of ductwork temperature, is equal to the design operating temperature.

2 PRODUCTS

2.1 Adhesives, Fasteners, and Tape

.1 Contact bond cement:

.1 for quick setting for metal surfaces.

.2 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Bakor - No. 220-05
- Foster – Drion 85-75

.2 Adhesive for flexible closed cell foam insulation:

.1 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Armaflex 520BLV
- Armaflex Low VOC Spray Contact Adhesive
- Rubatex R-373

.3 Lap seal adhesive:

.1 for joints and lap sealing of vapour barriers.

.2 Volatile Organic Content: maximum 250 g/L.

Standard of Acceptance
- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

.4 Fibrous insulation adhesive:

.1 Volatile Organic Content: maximum 250 g/L.

Standard of Acceptance
- Childers CHIL-STIX FRN CP-82
- Foster No. 85-70

.5 Vapour barrier tape:

.1 colour matched and foil faced

.2 UL 181A listed.

Standard of Acceptance
- Johns Manville - Zeston Z-Tape

- MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft
- Compac Corp.
- Fattal Canvas Inc. - Insultape

.6 Weld Pins, Studs and Clips

Standard of Acceptance
- Midwest Fasteners
- Continental Studwelding

.7 Staples

.1 Monel, flare type, minimum size 12 mm (½ in).

.8 Tie Wire

.1 1.6 mm (16 ga) stainless steel with twisted ends.

.9 Caulking for sheetmetal jackets (outdoor use only)

.1 fast-drying, aluminum colour finish, flexible butyl elastomer based vapour barrier sealant.

Standard of Acceptance.
- Foster 95-44

2.2 Coatings and Membranes

.1 Reinforcing Membrane:

.1 synthetic fibre:

(a) Leno weave,
(b) indoor and outdoor use.

Standard of Acceptance
- Foster Mast-A-Fab

.2 glass-fibre fabric:

(a) indoor use.

Standard of Acceptance
- Childers Chil-Glas #5/#10

.3 glass-fibre fabric for use with elastomeric closed cell foam: (a) indoor use.

Standard of Acceptance
- Childers Chil-Glass #10

.2 Breather Coating - Indoors:

.1 for breather coatings and lagging adhesive,

.2 Volatile Organic Content: maximum 50 g/L.

.3 white in colour,

Standard of Acceptance
- Childers CP-50A HV2
- Foster 30-36

.3 Breather Mastic - Outdoors:

.1 for breather coatings and lagging adhesive,

.2 abrasion resistive, flexible,

.3 UV stabile,

.4 grey in colour.

Standard of Acceptance
- Childers Vi-Cryl CP-10/11
- Foster 35-00 / 45-00
- Bakor 120-10

.4 Vapor Barrier Coatings - Indoors:

.1 Volatile Organic Content: maximum 50 g/L.

.2 for vapor barrier coatings and lagging adhesive except for elastomeric closed cell foam, (a) permeance rating 0.02 perms maximum,
(b) white in colour

Standard of Acceptance
- Childers Chil Perm CP-34/35
- Foster 30-80, 30-90

.3 for use with elastomeric closed cell foam.

Standard of Acceptance
- Childers CHIL-SPRAY WB CP-56 Adhesive

.5 Vapor Barrier Mastic - Outdoors:

.1 for vapor barrier coatings and lagging adhesive,

.2 asphalt cutback,

.3 permeance rating 0.02 perms maximum,

.4 grey in colour.

.5 for outdoor use only; not rated to meet fire/smoke rating of 25/50.

Standard of Acceptance
- Childers Chil-Pruf CP-22
- Foster 60-25/60-26

2.3 Field Applied Finishes

.1 PVC (Polyvinyl Chloride) finish jacket:

.1 minimum 20 mil thickness with permeability not more than 0.09 perms,

.2 flexible flat-sheet,

Standard of Acceptance
- Johns Manville - Manville Zeston 2000
- ACWIL Insulations
- Sure Fit Systems
- Proto PVC - LoSMOKE

.3 pressure sensitive, colour matching vinyl tape.

.2 Fabric finish jacket:

.1 ULC listed plain weave cotton fabric at 220 g/m2 (6 oz/sq yd), treated with fire retardant lagging adhesive, or

.2 re-wettable fiberglass lagging fabric with water activated self-adhesive.

.3 suitable for field painting.

Standard of Acceptance
- Fattal's Thermocanvas
- Alpha-Maritex 3451-RW
- Clairmont Diplag 60
- Glass-Cell FR
- Newtex - Zetex Rewettable

.3 Metal finish jacket:

.1 equipment:

(a) stucco embossed aluminum not less than 0.45 mm (0.016 in) thick sheet
or, (b) corrugated stainless steel not less than 0.25 mm (0.010 in) thick sheet.

.2 fittings:

(a) Custom made swaged ring or lobster back covers on bends and die shaped fitting covers over fitting, valves, strainers, flanges, and grooved couplings.

.3 bands:

(a) 12 mm (½ in) wide stainless steel with mechanical fasteners.

Standard of Acceptance
- Alcan Canada Products - Thermaclad Type 1
- Childers Products Inc. - Fab Straps

.4 Protective finish for elastomeric cellular foam insulation

.1 indoors and outdoors:

Standard of Acceptance
- Armaflex WB Finish

2.4 Ductwork Insulation

.1 Type D-1 glass fibre blanket:

.1 to ASTM C1290

.2 service temperature: up to 121°C (250°F)

.3 flexible blanket,

.4 FSK jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.

.5 noncombustible,

.6 thermal performance: R = 0.74 m^2 °C/W @ 24°C (4.2 btu ft^2 °F /Btu @ 75°F)

.7 density: 12 kg/m^3 (0.75 pcf)

.8 vapor transmission : maximum 0.02 perms

Standard of Acceptance
- John Manville Microlite XG Duct Wrap

- Owens Corning SOFTR Duct Wrap
- Knauf Fibreglass Friendly Feel Duct Wrap

.2 Type D-2 glass fibre board:

.1 to ASTM C612,

.2 service temperature: up to jacket surface temperature (air contact) up to 66°C (150°F) and un- jacketed surface temperature (equipment contact) up to 232°C (450°F).

.3 rigid for flat surfaces or,

.4 scored board for curved surfaces 250 mm (10 in) dia and over,

.5 jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn,

.6 thermal performance: 0.033 W/m/C @ 24°C (0.23 btu/hr/in/sq ft/F @ 75°F),

.7 vapor transmission: maximum 0.02 perms

.8 density: 48 kg/m3 (3.0 lb/cu ft),

.9 suitable for jacket surface temperature (air contact) up to 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).

Standard of Acceptance
- Johns Manville - Manville 814 Spin-Glas
- Owens Corning - 703 Board
- Knauf Fiberglass - Insulating Board

.3 Type D-3 flexible elastomeric closed cell foam:

.1 to ASTM C534,

.2 service temperature: up to 82°C (180°F).

.3 sheet self-adhering, roll type,

.4 thermal performance: 0.04 W/m/C @ 24°C (0.28 btu/hr/in/sq ft/F @ 75°F),

.5 manufacturer specific sealer/adhesive.

Standard of Acceptance
- Armstrong - AP Armaflex Self-Adhering Sheet Insulation
- Rubatex

.4 Type D-4 low temperature phenolic board:

.1 to ASTM C1126 (Gr.1),

.2 service temperature: -73ºC to+121ºC (-100ºF to 250ºF).

.3 rigid for flat surfaces,

.4 meeting 25/50 flame spread/smoke development when tested to ASTM E84,

.5 thermal performance: 0.021 W/m/Cº@ 10ºC (0.145 btu/hr/in/sq ft/Fº @ 50ºF),

.6 density: 37 kg/m3 (2.3 lb/cuft),

Standard of Acceptance
- Kingspan - Koolphen K

3 EXECUTION

3.1 Insulation Limits

.1 Externally insulate air handling system components:

- .1 Conditioned air with cooling coils: supply unit casings and plenums, and free standing supply fans for both recirculating and non-recirculating type systems,
- .2 Conditioned air with heating only: supply unit casing and plenums, free-standing supply fans, and supply air ducts and plenums up to the space served but not in the space itself,
- .3 Conditioned air supply ducts including downstream of reheat coils,
- .4 un-conditioned supply air ducts and plenums that pass through unheated rooms or spaces,
- .5 the first 300 mm (12 in) length of acoustically lined ductwork,
- .6 return air ducts and plenums in unheated spaces,
- .7 exhaust air ducts and plenums in unheated spaces,
- .8 exhaust air ducts between exhaust air damper and point of discharge to outside of building,
- .9 outside air intake ducts and plenums;
  - (a) for non-recirculating type ventilation systems without cooling coils, terminate plenum or casing insulation 300 mm (12 in) downstream of final heating coil,
- .10 mixed air plenums and ducts;
  - (a) for recirculating type ventilation systems without cooling coils, terminate outside air intake insulation 300 mm (12 in) downstream of mixing plenum,
- .11 sheet metal blank-off plates behind unused sections of air intake louvres.

.2 Externally insulate ductwork located outdoors:

- .1 supply ducts.
- .2 conditioned supply ducts.
- .3 return ducts,
- .4 exhaust ducts,
  - (a) excluding fan discharge duct,
- .5 kitchen exhaust ducts with more than 3 m (10 ft) length of duct on roof. (a) excluding fan discharge duct.

.3 External insulation is not required on:

- .1 casings, ducts or plenums which have been lined with acoustic insulation, except as described above,
- .2 free standing unconditioned supply fans, supply ducts and plenums,
- .3 portions of intake ducts or plenums, unit casings and conditioned air plenums which are of double wall insulated construction,
- .4 pre-insulated flexible ducts.
- .5 factory insulated air handling units.

3.2 General Requirements

.1 Insulate ductwork in accordance with Table 1 at the end of this section.

.2 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.

.3 Surfaces to be clean and dry before application of insulation. Apply insulation after pressure and leakage testing is completed and accepted.

.4 Place insulation with joints staggered and tightly butted, with no visible gaps.

.5 Neatly finish insulation at supports, protrusions, and interruptions.

.6 Seal exposed insulation with reinforced vapor barrier or breather coating/mastic as shown.

.7 Finish ductwork with field installed finish jackets as shown.

3.3 Application

.1 Rigid insulation - fans, ducts, and casing:

.1 overlap horizontal boards over vertical boards, and butt edges tightly together.

.2 impale insulation on weld pins, studs, and clips at 300 mm (12 in) centres in both directions, with not less than 2 rows per side and bottom.

.3 secure insulation laps with mechanical fasteners (staples).

.2 Rigid insulation - outside air duct and plenums - glass fibre:

.1 as above for fans, ducts, and casings, and;

(a) apply first layer of insulation without integral vapour barrier,
(b) apply second layer of insulation with integral vapour barrier with staggered joints.

.3 Rigid insulation - outside air duct and plenum - phenolic board:

.1 as above for fans, ducts, and casings, but with only one layer of insulation board.

.4 Rigid insulation - exhaust air plenums:

.1 as above for fans, ducts, and casings.

.5 Flexible insulation:

.1 overlap insulation 50 mm (2 in) on each lap joint, and butt end edges tightly together,

.2 on rectangular ducts 600 mm (24 in) and wider, and round ducts 450 mm (18 in) and wider;

(a) secure insulation to the underside of duct with weld pins, studs, and clips at 300 mm (12 in) centres in both directions, with not less than 2 rows per side and
bottom, (b) secure insulation laps with mechanical fasteners (staples),
(c) for round ductwork, the underside of duct is measured as being half the circumference of the duct.

.6 Flexible elastomeric:

.1 wrap tightly onto ductwork and drain pans, and secure with 100% adhesive coverage.

.2 on round ducts, overlap insulation 50 mm (2 in) on each lap joint, and butt end edges tightly together,

.7 Cover angles or standing seams on the outside of plenums, casings and ducts which extend beyond face of applied rigid insulation;

.1 with same material and thickness as adjacent ductwork,

.2 extend this insulation 75 mm (3 in) on each side of the angle and place tight around the projecting leg of the angle.

.3 apply rigid insulation overlapping edge of flexible insulation on angle so that outstanding part of insulated angle projects through work.

.8 Cut and mitre rigid insulation at elbows and fittings and attach to ductwork with 50% coverage of adhesive, and mechanical fasteners with weld pins, speed clips and washers.

.9 Attach speed washers when insulation has been placed on metal pins and cut off excess pin length flush with speed washer. Cover washers with vapour barrier tape.

.10 At junctions between external insulation and acoustic insulation, overlap external insulation 300 mm (12 in) over acoustic lining.

.11 Outdoor rectangular and flat-oval ductwork:

.1 build-up and slope insulation on top of ductwork to provide a 1:100 drainage slope,

.2 where width of ductwork exceeds 600 mm (24 in), slope insulation in both directions.

3.4 Sealing Insulation

.1 Hot ducts, casings, and plenums - Indoors:

.1 service temperature: 20°C to 65°C (70°F - 150°F)

.2 apply vapour barrier tape to butt joints, overlapping my minimum 50 mm (2 in) each

.3 do not tape lap joints.

.2 Cold or dual temperature ducts, casings, and plenums - Indoors:

.1 service temperature: Ambient to 20°C (Ambient to 70°F)

.2 apply reinforced vapor barrier coating to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side,

.3 cover mechanical fastener (staple) penetrations with reinforced vapour barrier coating,

.4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced vapour barrier coating.

.3 Ducts - Hot ducts - Outdoors:

.1 service temperature: 20°C to 65°C (70°F - 150°F)

.2 apply reinforced breather mastic to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side.

.3 cover mechanical fastener (staple) penetrations with reinforced breather mastic,

.4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced breather mastic.

.5 for greater clarity, do not use vapor barrier tape on outdoor applications.

.4 Ducts - Cold or Dual Temperature - Outdoors:

.1 service temperature: Ambient to 20°C (Ambient to 70°F)

.2 apply reinforced vapor barrier mastic to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side,

.3 cover mechanical fastener (staple) penetrations with reinforced vapour barrier mastic,

.4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced vapour barrier mastic,

.5 for greater clarity, do not use vapor barrier tape on outdoor applications.

.5 Apply mastics and coatings when ambient temperature is above 4°C (40°F), unless manufacturer's instructions permit colder ambient installation conditions.

3.5 Insulation Finish

.1 Install protective finish on insulation in accordance with Table 2 at the end of this Section, after breather and vapor barrier sealing is completed.

.2 Install finish jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) overlap on longitudinal and circumferential edges.

.3 Fabric:

.1 Cotton lagging:

(a) apply cotton lagging with minimum two coatings of breather or vapor barrier coating adhesive as applicable to the duct system, and finish to provide a smooth surface free of wrinkles and sags.
(b) where cotton lagging with appropriate coating is used this satisfies the requirements of a sealer coating for Hot or Cold/Dual temperature ducting systems.

.2 Fibreglass lagging:

(a) apply re-wettable fibreglass lagging in accordance with manufacturer instructions. Finish to provide a smooth surface free of wrinkles and sags.
(b) where re-wettable fiberglass lagging is used this satisfies the requirements of a breather sealer coating for Hot piping systems.

.4 Metal:

.1 use lock-on systems or secure sheeting with bands 450 mm (18 in) apart.

.2 joint sealing, indoor:

(a) Hot ducts and plenums: do not seal joints.
(b) Cold or Dual Temperature ducts and plenums: seal joints with caulking.

.3 curved surfaces: custom made swaged ring or lobster back covers,

.4 on outdoor hot and cold/dual temperature ductwork, caulk overlapping metal joints to permit expansion of metal jacket.

.5 Flexible elastomeric closed cell foam insulation:

.1 apply thin coat of lagging adhesive, and apply glass mesh,

.2 when dry apply indoor or outdoor finish at 400 square feet per gallon,

.3 apply second coat of same material, at same rate of application, after four hours.

3.6 Painted Ductwork

.1 Not applicable.

3.7 Mechanical Damage Protection - Indoors

.1 Protect exposed insulated ductwork from floor level up to 1200 mm (4 ft) above floor with 1.2 mm (18 ga) stainless steel jacket, secured to floor slab.

.2 Do not overlap fire damper slip joint with protective sheeting.

3.8 Field Quality Control

.1 The Consultant reserves the right to have protective finish coverings removed on up to 5% of all fittings and flanges to review the sealing of the insulation, at no change in cost.

.2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings and flanges for review.

.3 Repair defective sealing and replace protective coverings at no change in cost.

3.9 Insulating and Finishes Tables

.1 Tables 1, and 2 follows.

Table 1 : Ductwork and Plenum Insulation Type and Thickness mm (in)

Nominal Surface Temperatur	Equipment Description	Insulation Type	Insulation Thickness
5°C to 65°C (40F to 150F)	Supply unit casings and plenums Free standing supply fans Rectangular, exposed Rectangular, concealed	D-2	25 (1)
	Rectangular, concealed Round and Oval, exposed Round and Oval, concealed	D-1	38 (1-1/2) note (1)
Ambient to 65°C (Ambient to 150F)	Plenums and Casings - Air Intake	D2	Two layers each 50 (2)
		D4	75 (3)
	Plenums and Casings - Exhaust	D2	50 (2)
		D4	38 (1-1/2)
	Rectangular - Outdoor - Supply	D2	50 (2)
	Rectangular - Outdoor - Return Rectangular - Outdoor - Exhaust	D2	38 (1-1/2)
	Round - Outdoor	D3	Two layers each 25 (1)

Table 1 : Ductwork and Plenum Insulation Type and Thickness mm (in)			
Nominal Surface Temperature	Equipment Description	Insulation Type	Insulation Thickness
	Drain pans	D3	20 (3/4)

Note (1): thickness is “out of box” before installation.

Table 2 : Ductwork Insulation Protective Finishes			
Location	Weather Exposure	System/Space	Finish
Concealed	Indoors	All	None
Exposed	Indoors	Service Rooms	Fabric
	Indoors	Public Spaces	Fabric
	Outdoors	All	Metal

END OF SECTION

PIPING INSULATION
20 07 19

1 GENERAL

1.1 Scope

.1 Insulate and finish piping, valves, fittings, and pipeline accessories.

.1 provide insulation, coatings, finishes, and mechanical protection.

.2 Provide fire rated insulation on piping as shown, including fire protection standpipes.

.1 coordinate with the contractor under Division 21 for location and extent of standpipes to be protected.

1.2 Related Work

.1 The following Work is specified in other Section of Division 20:

.1 supply of insulation shields for cold and dual temperature piping:

.2 provision of welded saddles for hot piping.

.2 Insulation of underground piping: Section 20 07 21.

.3 Painting of piping: Division 09.

1.3 Quality

.1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics may be acceptable but must be submitted as an alternative product submission.

1.4 Qualifications

.1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

Standard of Acceptance
- Custom Insulation Systems
- Guaranteed Insulation Ltd
- White & Greer Co Ltd
- Dewpoint Insulation Systems

1.5 Sample Boards

.1 Submit sample assembly of each type of insulation and covering. Mount samples on PVC coroplast board with typewritten label beneath each sample indicating service and material specification.

.2 Include samples of vapor barrier installation including coatings (indoors), mastics (outdoors), reinforcing membranes, on a sample of a pipe butt joint and one elbow.

1.6 Material test criteria

.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:

.1 maximum flame spread rating of 25 to CAN/ULC-S102,

.2 maximum smoke developed rating of 50 to CAN/ULC-S102..

.2 Exception: vapor barrier mastics installed outside of building.

1.7 Applicable codes and standards

.1 Material and method of application to comply with or be tested in accordance with following Standards;

.1 Thermal Insulation Association of Canada (TIAC) National Insulation Standard, excluding section 12

.2 NFPA 90-A Installation of Air-Conditioning and Ventilating Systems

.3 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

.4 NFPA 255 Test of Surface Burning Characteristics of Building Materials

.5 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies

.6 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation

.7 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus

.8 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

.9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

.10 ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation

.11 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation

.12 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.13 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.14 ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

.15 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation

.16 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.

.17 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

1.8 Definitions

.1 In this Section;

.1 “Ambient”: as applied to temperatures means outdoor design temperature.

.2 "Concealed": as applied to mechanical services and equipment located in space above opaque suspended ceilings, and within trenches not in boiler rooms, pipe and/or duct shafts, and non- accessible chases and furred spaces.

.3 "Exposed": as applied to remainder of mechanical services and equipment which are not

"concealed" as defined above. For greater certainty, the following locations are Exposed:

(a) Services in tunnels,
(b) Services in space beneath raised floors.
(c) Trenches located in boiler rooms.

.4 "Conditioned air": air supplied from air handling units which heats, cools, dehumidifies, or humidifies the air.

.5 "Unconditioned space": rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system

.6 "Outdoor": mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.

.7 "Mastic": heavy-consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.

.8 "Coating": light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.

.9 "Finish Jacket": final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films; that provides weather-protective finish depending on application.

.10 "Service temperature": for purpose of piping temperature, is equal to the gas or vapour design operating temperature, or the liquid supply operating temperature.

.11 "Pure water": water which has been treated with filtration equipment, including but not limited to reverse osmosis, deionization, ultra-filtration, ultra-violet, distillation or any combination of such or similar equipment, to achieve water quality significantly free of impurities.

2 PRODUCTS

2.1 Adhesives, Fasteners, and Tape

.1 Contact bond cement:

.1 for quick setting for metal surfaces.

.2 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Bakor - No. 220-05
- Foster – Drion 85-75

.2 Adhesive for flexible closed cell foam insulation:

.1 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Armaflex 520 BLV
- Armaflex Low VOC Spray Contact Adhesive
-

.3 Lap seal adhesive:

.1 for joints and lap sealing of vapour barriers.

.2 Volatile Organic Content: maximum 250 g/L.

Standard of Acceptance
- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

.4 Fibrous insulation adhesive:

.1 Volatile Organic Content: maximum 250 g/L

Standard of Acceptance
- Childers CHIL-STIX FRN CP-82
- Foster No. 85-70

.5 Vapour barrier tape:

.1 colour matched and foil faced

.2 UL 181A listed.

Standard of Acceptance
- Johns Manville - Zeston Z-Tape
- MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft
- Compac Corp.
- Fattal Canvas Inc. - Insultape

.6 Weld Pins, Studs and Clips:

Standard of Acceptance
- Midwest Fasteners
- Continental Studwelding

.7 Staples:

.1 Monel, flare type, minimum size 12 mm (½ in).

.8 Tie Wire:

.1 1.6 mm (16 ga) stainless steel with twisted ends.

.9 Caulking for sheetmetal jackets (outdoor use only)

.1 fast-drying, aluminum colour finish, flexible butyl elastomer based vapour barrier sealant.

Standard of Acceptance.
- Foster 95-44

2.2 Coatings and Membranes

.1 Reinforcing Membrane:

.1 synthetic fibre:

(a) Leno weave,
(b) indoor and outdoor use.

Standard of Acceptance
- Foster Mast-A-Fab

.2 glass-fibre fabric:

(a) indoor use.

Standard of Acceptance
- Childers Chil-Glas #5/#10

.3 glass-fibre fabric for use with elastomeric closed cell foam: (a) indoor use.

Standard of Acceptance
- Childers Chil-Glass #10

.2 Breather Coating - Indoors:

.1 for breather coatings and lagging adhesive,

.2 Volatile Organic Content: maximum 50 g/L

.3 white in colour,

Standard of Acceptance
- Childers CP-50A HV2
- Foster 30-36

.3 Breather Mastic - Outdoors:

.1 for breather coatings and lagging adhesive,

.2 abrasion resistive, flexible,

.3 UV stabile,

.4 grey in colour.

Standard of Acceptance
- Childers Vi-Cryl CP-10/11
- Foster 35-00 / 45-00
- Bakor 120-10

.4 Vapor Barrier Coatings - Indoors:

.1 Volatile Organic Content: maximum 50 g/L.

.2 for vapor barrier coatings and lagging adhesive except for elastomeric closed cell foam, (a) permeance rating 0.02 perms maximum, (b) white in colour

Standard of Acceptance
- Childers Chil Perm CP-34/35
- Foster 30-80, 30-90

.3 for use with elastomeric closed cell foam.

Standard of Acceptance
- Childers CHIL-SPRAY WB CP-56 Adhesive

.5 Vapor Barrier Mastic - Outdoors:

.1 for vapor barrier coatings and lagging adhesive,

.2 asphalt cutback,

.3 rermeance rating 0.02 perms maximum,

.4 grey in colour.

.5 for outdoor use only; not rated to meet fire/smoke rating of 25/50.

Standard of Acceptance

- Childers Chil-Pruf CP-22
- Foster 60-25/60-26

2.3 Insulation Cement

.1 Hydraulic-setting finishing type.

2.4 Field Applied Finishes

.1 PVC (Polyvinyl Chloride) finish jacket:

.1 minimum 20 mil thickness with permeability not more than 0.09 perms,

.2 fitting covers, one or two piece, pre moulded,

.3 glass-fibre insulation inserts for elbows, tees, valves, end-caps, mechanical pipe couplings,

.4 self sealing longitudinal joints.

Standard of Acceptance
- Johns Manville - Manville Zeston 2000
- ACWIL Insulations
- Sure Fit Systems
- Proto PVC - LoSMOKE

.5 pressure sensitive, colour matching vinyl tape.

.2 Metal finish jacket:

.1 straight pipe, duct or plenum:

(a) 30 gauge aluminum cladding

.2 fittings:

(a) Custom made swaged ring or lobster back covers on bends and die shaped fitting covers over fitting, valves, strainers, flanges, and grooved couplings.

.3 bands:

(a) 12 mm (½ in) wide stainless steel with mechanical fasteners.

Standard of Acceptance
- Alcan Canada Products - Thermaclad Type 1
- Childers Products Inc. - Fab Straps
-

.3 Protective finish for elastomeric cellular foam insulation

.1 indoors and outdoors:

Standard of Acceptance
- Armaflex WB Finish

2.5 Pipe Insulation

.1 Type P-1 molded glass fibre:

.1 to ASTM C547,

.2 pipe size application: up to and including NPS 24:

.3 service temperature: -18°C (0°F) to jacket surface temperature (air contact) of 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).

.4 factory molded rigid pipe insulation,

.5 ASJ jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.

.6 self sealing longitudinal jacket with integral vapour barrier, and matching butt joint sealer strips.

.7 noncombustible,

.8 thermal performance: 0.033 W/m/C @ 24°C (0.23 btu/hr/in/sq ft/F @ 75°F)

.9 vapor transmission : maximum 0.02 perms

.10 reduced environmental impact feature of either: bio-based binders, 25% minimum recycled glass content, and/or paper-free ASJ jacket material.

Standard of Acceptance

- John Manville — Micro-Lok HP (25% recycled content)
- Owens Corning — Fiberglas Evolution (paper-free ASJ)
- Knauf Fiberglass — Redi-Klad 1000 Ecose (bio-based binders)

.2 Type P-2 glass fibre semi-rigid board:

.1 to ASTM C795,

.2 pipe size application: NPS 16 and larger:

.3 service temperature: up to 454°C (850°F)

.4 scored and folded board,

.5 ASJ jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.

.6 noncombustible,

.7 thermal performance: 0.050 W/m/C @ 93°C (0.35 btu/hr/in/sq ft/F @ 200°F)

.8 vapor transmission : maximum 0.02 perms

Standard of Acceptance

- John Manville — Spin-Glas 813
- Owens Corning — Pipe and Tank
- Knauf Fibreglass — Pipe and Tank

.3 Type P-3 flexible elastomeric closed cell foam:

.1 to ASTM C534,

.2 pipe size application: up to and including NPS 1-1/2

.3 service temperature: -183°C (-297°F) to 82°C (183°F)

.4 tubular with self sealing seams,

.5 thermal performance: 0.04 W/m/C @ 24°C (0.28 btu/hr/in/sq ft/F @ 75°F),

.6 manufacturer specific sealer/adhesive.

Standard of Acceptance

- ARMACELL - AP Armaflex SS Pipe Insulation
- Rubatex

.4 Type P-4 molded phenolic rigid:

.1 to ASTM C1126 (Gr.1),

.2 pipe size application: up to and including NPS 16

.3 service temperature: -73ºC to +121ºC (-100ºF to 250ºF).

.4 molded pipe, fitting, and hanger supports,

.5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,

.6 thermal performance: 0.019 W/m/Cº@ 24ºC (0.13 btu/hr/in/sq ft/Fº @ 75ºF),

Standard of Acceptance
- Kingspan - Kooltherm K/Kooltherm

.5 Type P-5 cellular glass:

.1 to ASTM C552,

.2 pipe size application: up to and including NPS 16

.3 service temperature: -268°C (-450°F) to 480°C (900°F)

.4 density 120 kg/m3 (7.5 lb/cu ft),

.5 molded or block type,

.6 thermal performance: 0.043 W/m/C @ 0°C (0.32 btu/hr/in/sq ft/F @ 75°F).

Standard of Acceptance
- Pittsburgh Corning Foamglas

.6 Type P-6 calcium silicate:

.1 to ASTM C533,

.2 pipe size application: up to and including NPS 16

.3 service temperature: to 649°C (1200°F).

.4 density 232 kg/m3 (14.5 lb/cu ft),

.5 molded or block type,

.6 asbestos-free,

.7 thermal performance: 0.058 W/m/C @ 149°C (0.40 btu/hr/in/sq ft/F @ 300°F),

Standard of Acceptance
- Industrial Insulation Group - Thermo-12/Blue

.7 Type P-7 molded mineral wool fibre:

.1 to ASTM C547,

.2 pipe size application: up to and including NPS 30,

.3 service temperature: up to 650°C (1200°F),

.4 rigid molded type,

.5 thermal performance: 0.04 W/m/C @ 50°C (0.25 btu/hr/in/sq ft/F @ 100°F),

Standard of Acceptance
- Roxul Techton 1200
- Fibrex Coreplus 1200 Pipe Insulation

.8 Type P-8 molded mineral wool fibre high temperature:

.1 to ASTM C547,

.2 pipe size application: up to and including NPS 30

.3 service temperature: up to 730°C (1350°F),

.4 rigid moulded type,

.5 thermal performance: 0.04 W/m/C @ 50°C (0.25 btu/hr/in/sq ft/F @ 100°F),

Standard of Acceptance
- Roxul SturdiRock
- Fibrex Dura K Pipe Insulation

.9 Type P-9 removable/reuseable high temperature insulated jackets:

.1 custom fabricated, removable insulation covers for hot surfaces,

.2 suitable for outdoor use,

.3 maximum touch-safe temperature protection : 95°C (203°F) to UL2200.

.4 insulation: high density, fire resistant mineral or fibreglass insulation suitable for system operating temperature.

.5 cover: silicone impregnated fibreglass cover, for temperatures up to 260°C (500°F).

.6 internal liner: silicone impregnated fibreglass fabric, or stainless steel knitted wire mesh.

.7 single piece construction

.8 metal identification tag, referenced equipment served.

.9 tie-straps with D-rings, or Velcro™ closures.

Standard of Acceptance
- Firwin Corporation
- Thermohelp Canada Inc.

.10 Type P-10 fire-rated pipe insulation:

.1 WH, ULC, or UL classified inorganic material, non-combustible, listed for protection of metallic piping,

.2 meeting ASTM C518,

.3 flexible blanket, 2 hour fire rating,

.4 foil encapsulated,

.5 suitable for service between: -173°C to 1260°C (-280°F to 2300°F).

Standard of Acceptance
- Eastern Wire & Conduit (Royal Quickstop Quickwrap)

.11 Type P-11 molded phenolic rigid pipe support inserts:

.1 molded pipe hanger supports on cold and dual temperature piping,

.2 to ASTM C1126 (Gr.1),

.3 pipe size application: up to NPS 24

.4 service temperature: -73ºC to+121ºC (-100ºF to 250ºF).

.5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,

.6 density: 120 kg/m^3 (7.5 lb/ft^3)

Standard of Acceptance

- Kingspan - Kooltherm K/Kooltherm High Density

3 EXECUTION

3.1 General Requirements

.1 Apply insulation after pressure and leakage testing is completed and accepted, and heat tracing is installed.

.2 Surfaces to be clean and dry before application of insulation.

.3 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.

.4 Do not apply insulation on chrome plated surfaces of piping, valves, fittings, and equipment.

.5 Cut and bevel insulation around nameplates and pressure vessel stamps.

.6 Neatly finish insulation at supports, protrusions, and interruptions.

.7 Seal exposed insulation with reinforced vapor barrier or breather coating or mastic.

.8 Finish piping with field installed finish jackets as specified herein.

3.2 Hot Piping Systems Insulation

.1 Insulate hot piping systems including pipe, valves, fittings, and pipeline accessories in accordance with Table 1 at the end of this Section.

.2 Insulate Condensate piping to the same criteria as its associated steam system.

.3 Insulate Safety Relief valve piping located between floor or elevated work surface and up to 2400 mm (8 ft) above same, and passing within 1200 mm (4 ft) of a floor or elevated work surface.

3.3 Cold and Dual Temperature Piping Systems Insulation

.1 Insulate cold and dual temperature piping systems including pipe, valves, fittings, and pipeline accessories in accordance with Table 2 at the end of this Section.

.2 For drainage systems insulate:

.1 storm water roof drain body,

.2 storm water piping from roof drain body to the floor level of the story below the drain body

.3 sanitary piping in the following locations,

(a) exposed sanitary drainage piping in IT/Data rooms,
(b) exposed sanitary drainage piping in service tunnels
(c) exposed sanitary drainage piping serving spaces located above a parking garage open to the outdoors,
(d) and where shown on drawings

.3 For greater clarity, domestic hot water, domestic hot water recirculating, non-potable hot water, and non-potable hot water recirculating piping systems are treated as “cold and dual temperature” for the purpose of application of vapor barriers to both hot and cold domestic and non-potable water piping.

3.4 Piping

.1 Insulate straight pipe sections by staggering adjacent longitudinal seams 1/4 turn each butt joint.

.2 Secure insulation at centre of each section, at each end, and at not more than 600 mm (2 ft) intervals with:

.1 vapor barrier tape in addition to jackets with self-adhering lap joints for type P1 and P2 insulation on Cold and Dual Temperature piping,

.2 mechanical fastened (stapled) or jackets with self adhering lap joints on type P1 and P2 insulation on Hot piping,

.3 bands or wire for type P4 to P8 insulation,

.4 self-adhered or provide 100% coverage of contact adhesive for type P3 insulation,

.5 in accordance with listing requirements for type P10 insulation.

3.5 Fittings, Flanges, Couplings, and Strainers

.1 Insulate fittings including elbows and tees:

.1 NPS 1½ and smaller:

(a) mitre cut insulation to create tight fit,
(b) for PVC cover, trim backside of insulation on elbows to suit cover but do not reduce total thickness less than that of adjacent pipe insulation.

.2 NPS 2 and larger:

(a) use matching preformed insulation inserts, or fabricate mitred insulation segments made from same material as pipe insulation,
(b) number of mitred segments to be sufficient to maintain thickness of insulation around throat of elbow,
(c) secure inserts and fabricated segments with wire prior to application of coatings or finishes.

.2 Insulate flanges and grooved joint couplings:

.1 Insulate with preformed inserts or build-up insulation with same material as on adjacent

pipe: (a) butt pipe insulation to each side of flange, coupling, valve, or strainer,
(b) build up rigid insulation blocking on each side of fitting, coupling, valve or strainer, with a width dimension same as pipe insulation thickness, and
(c) apply insulation layer over outside of flange, coupling, valve or strainer to a thickness equal to pipe insulation thickness.
(d) provide removable insulation section on strainer head.

.2 Where phenolic insulation is used;

(a) same as above except use factory made insulation inserts, or fabricate inserts to suit fixture.

.3 Where elastomeric insulation is used;

(a) same as above except adhere insulation to flange, coupling, or strainer with full coverage of °C adhesive,
(b) do not adhere insulation across bolted connections - insulate on each side of connection and add additional insulation layer across connection and fix in place with bands.

3.6 Pipeline Accessories

.1 Insulate pipeline accessories:

- .1 valves
- .2 strainers
- .3 pressure reducing valves
- .4 safety valves
- .5 meters
- .6 steam separators

.2 No insulation is required on pipeline accessories for Hot Piping systems with design temperatures of 93°C (200°F) or less.

.3 Insulate accessories for Cold and Dual Temperature Piping systems for chilled water and liquid refrigerant piping:

- .1 one layer of 25 mm (1 in) type P-3 elastomeric blanket insulation adhered to pipeline accessories with 100% adhesive coverage.
- .2 at locations requiring access, extend insulation to create collar around bolted connection, and install a compression fit piece of insulation to cover equipment.

.4 Insulate accessories for all other Cold and Dual Temperature Piping systems:

- .1 insulate with flexible blanket of same material and thickness of adjacent piping and seal with reinforced vapor barrier sealer.
- .2 at locations requiring access including valve handles, valve actuators, drain valves, etc. cut-back insulation and seal exposed edges.

3.7 Drainage Systems - Additional Requirements

.1 Insulate underside of roof drain hoppers with flexible blanket insulation of same type as pipe insulation.

3.8 Cold and Dual Temperature Pipe Insulation Systems - Additional Requirements

.1 Insulate pipe anchor plates and frames with flexible elastomeric closed cell foam insulation blanket of type P-3 insulation and seal with vapour barrier coating.

.2 Extend insulation along anchor steel a minimum distance of 150 mm (6 in) outside the piping insulation thickness.

3.9 Hangers and Supports

.1 Provide insulation protection in accordance with Table 3 at the end of this Section, based on pipe size and service process temperature.

.2 Pipe saddle insulation protection:

- .1 insulate the interior void spaces of pipe saddles, of same material as adjacent pipe insulation,
- .2 butt insulation up to sides and end of pipe saddle, and leave bottom surface of saddle exposed for direct contact with pipe support.

.3 Pipe shield insulation protection:

.1 install insulation shield between outside of insulation and pipe support; pipe support is sized for outside dimension of insulation.

.2 in accordance with pipe size, provide high density insulation insert of same thickness as adjacent pipeline material, fabricated from:

(a) cold and dual temperature piping: type P-11 (phenolic),
(b) hot piping: type P-11 (phenolic),. (c) 300 mm (12 in) long for pipe size up to NPS 3, and
(d) 450 mm (18 in) long for pipe sizes NPS 4 and larger.

3.10 Floor and Wall Sleeves

.1 Extend pipe insulation including coatings and finishes through floor and wall sleeves.

.2 For penetrations through fire rated separations, provide finishes in accordance with fire stopping manufacturer's listing requirements.

.3 For outdoor piping passing through exterior walls or roof, terminate mastic lagging at outside face of sleeve and protected by storm flashing, caulked to lagging and to building structure.

3.11 Sealing Insulation

.1 Apply coatings and mastic in accordance with manufacturer requirements.

.1 Hot piping: breather coating/mastic

.2 Cold and Dual Temperature piping: vapor barrier coating/mastic

.2 Only use mastics on outdoor installations.

.3 Apply mastics and coatings when ambient temperature is above 4°C (40°F), unless manufacturer's instructions permit colder ambient installation conditions.

.4 Hot Piping;

.1 seal lap joints with self-adhesive lap joint, reinforced breather coat, or vapour barrier tape,

.2 seal butt joints with matching vapour barrier tape.

.5 Cold and Dual Temperature Piping;

.1 tightly seal insulation with factory applied all-purpose jacket using self-adhering or field applied adhesive on longitudinal laps and butt joint.

(a) where sealing strips are damaged, apply secondary layer of colour matched vapor barrier tape.

.2 seal insulation without factory applied jackets with 100% coverage of vapor barrier coating/mastic as applicable complete with reinforcing membrane.

.3 seal insulation butt ends with vapor barrier coating every four (4) lengths of insulation but not to exceed 2400 mm (8 ft) of pipe length.

.6 Hanger high-density insulation inserts:

.1 seal inserts with reinforced breather or vapour barrier coating as applicable, overlapping adjacent insulation a minimum of 50 mm (2 in).

.7 Elbows, tees, flanges, and fittings;

.1 Apply applicable breather or vapor barrier coating/mastic with reinforcing membrane over fitting insulation and overlap 50 mm (2 in) onto adjacent pipe insulation.

(a) for greater clarity, use of vapor barrier tape to seal insulation is not permitted.

.2 Apply coating/mastic and reinforcing membrane regardless of final finish application.

.8 Maintain integrity of vapor barrier through sleeves, around fittings and at hangers and supports.

3.12 Insulation Finish Coverings

.1 Install protective finish coverings on insulation in accordance with Table 4 at the end of this Section, after breather and vapor barrier sealing is completed.

.2 Cut finish jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) longitudinal overlap and similar circumferential overlap onto adjacent sheets.

.1 On vertical pipes arrange circumferential overlap on adjacent sheets outside of sheet below and under sheet above.

.3 PVC sheeting :

.1 Hot piping:

(a) overlap longitudinal edges and adjacent sheets by minimum of 50 mm (2 in) and staple fasten the sheets.
(b) secure sheeting with colour matched tape around circumference, at least two places per section of sheet, and by stapling longitudinal and circumferential edges.
(c) do not seal edges with vapour barrier tape.
(d) seal PVC fitting covers at throat and heel seams by stapling and secure over insulation by banding or taping ends to adjacent pipe finish covering with colour matched tape.

.2 Cold and Dual Temperature piping:

(a) overlap longitudinal edges and adjacent sheets by minimum of 50 mm (2 in) and seal longitudinal edges with vapor barrier coating adhesive for full depth and 100% coverage of overlap,
(b) seal circumferential edges of PVC fitting covers with reinforced vapour barrier coating adhesive extending over adjacent pipe insulation section with an overlap of at least 50 mm (2 in).
(c) seal PVC fitting covers at throat and heel seams by solvent bonding and secured over insulation with reinforced vapor barrier coating/mastic overlapping adjacent pipe insulation a minimum of 50 mm (2 in).

.4 Metal:

.1 Use lock-on systems or secure sheeting with bands 450 mm (18 in) apart.

.2 Joint sealing:

(a) Hot pipe: do not seal joints.
(b) Cold and dual temperature pipe: seal joints with caulking.

.3 Curved surfaces: custom made swaged ring or lobster back covers.

.4 On outdoor hot and cold/dual temperature piping, caulk overlapping metal joints to permit expansion of metal jacket.

.5 Fabric:

.1 Cotton lagging:

(a) apply cotton lagging with minimum two coatings of breather or vapor barrier coating adhesive as applicable to the piping system, and finish to provide a smooth surface free of wrinkles and sags.
(b) where cotton lagging with appropriate coating is used this satisfies the requirements of a sealer coating for Hot or Cold/Dual temperature piping systems.

.2 Fiberglass lagging:

(a) apply re-wettable fiberglass lagging in accordance with manufacturer instructions. Finish to provide a smooth surface free of wrinkles and sags.
(b) where re-wettable fiberglass lagging is used this satisfies the requirements of a sealer coating for Hot piping systems.

3.13 Mechanical Damage Protection - Indoors

.1 Protect exposed pipe insulation extending up through a floor sleeve at floor line with 1.2 mm (18 ga) stainless steel jacket approximately 100 mm (4 in) high, secured to floor slab. Conceal fastenings by floor plate.

.2 For piping systems using metal finishes, this protection cover replaces a portion of the specified pipe cover.

.3 For piping systems using other finishes, this protection cover is in addition to the specified pipe cover.

3.14 Fire rated pipe Insulation

.1 Provide two (2) hour rating of type P-10 insulation on tube or pipe, where shown.

.2 Install insulation, including pipe hangers, in accordance with fire-rated insulation manufacturer's listing requirements.

3.15 Field Quality Control

.1 The Consultant reserves the right to have protective finish coverings removed on up to 5% of all fittings, flanges, couplings, valves, and pipeline accessories to review the sealing of the insulation, at no change in cost.

.2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings, flanges, couplings, valves, and pipeline accessories for review.

.3 Repair defective sealing and replace protective coverings at no change in cost.

3.16 Insulating and Finishes Tables

.1 Table 1, 2 and 3 follows.

Table 1 : Hot Piping Systems, Insulation Type and Thickness mm (in)

System	Fluid Nominal Temp. °C (F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
Steam and Condensate > 860 kPa (125 psi)	≥177 (351)	P-6 P-7	65 (2½)	75 (3)	75 (3)	100 (4)	100 (4)
Steam and Condensate > 100 kPa (15 psi) and ≤ 860 kPa (125 psi) Boiler Feed Water Safety relief piping	122 to 176 (251 to 350)	P-1 P-2 P-6 P-7	50 (2)	65 (2½)	75 (3)	90 (3½)	90 (3½)
Steam and Condensate ≤ 100 kPa (15 psi) High temperature hot water heating	94 to 121 (201 to 250)	P-1 P-2 P-7	38 (1½)	38 1(½)	50 (2)	50 (2)	90 (3½)
		P-4	20 (3/4)	20 (3/4)	25 (1)	38 (1½)	38 (1½)
Hot Water Heating Glycol Heating Pumped Condensate	61 to 93 (141 to 200)	P-1 P-7	38 (1½)	38 (1½)	38 (1½)	38 (1½)	38 (1½)
		P-4	20 (3/4)	25 (1)	25 (1)	25 (1)	25 (1)
Pure Water (during heat sanitization)	50 to 93 (122 to 200)	P-1 P-7	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)
Low Temperature Hot Water Heating	40 to 60 (105 to 140)	P-1	25 (1)	25 (1)	25 (1)	38 (1½)	38 (1½)
Low Temperature Glycol Heating		P-4	20 (3/4)	20 (3/4)	20 (3/4)	25 (1)	25 (1)
Condenser Water (outdoors)	26 to 39 (80 to 104)	P-1 P-5	25 (1)	25 (1)	25 (1)	38 (1½)	38 (1½)

Table 2 : Cold and Dual Temperature Piping Systems, Insulation Type and Thickness mm (in)

System	Fluid Nominal Temp. °C (F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
Dual Temperature Heating/Cooling	4.4 to 93 (40 to 200)	P-1	38 (1½)	38 (1½)	38 (1½)	38 (1½)	38 (1½)
Domestic Hot Water Domestic Hot Water Recirculation Not-Potable Hot Water Non-Portable Hot Water Recirculation	40.5 to 60 (105 to 140)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	38 (1 ½)
Domestic Cold Water Non-potable Water Drainage	4.4 to 16 (40 to 60)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	50 (2)
		P-4	---	---	---	25 (1)	25 (1)
Equipment Drains	4.4 to 16 (40 to 60)	P-3	13 (1/2)	20 (3/4)	25 (1)	---	---
Chilled Water Dual Temperature Heating/Cooling	4.4 to 16 (40 to 60)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	50 (2)
		P-4	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)
Refrigerant Suction	< 4.4 (< 40)	P-3	25 (1)	25 (1)	25 (1)	---	---
		P-4	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)

Table 3 : Insulation Hanger Protection				
Process Temperature °C (F)	Pipe Size NPS	Pipe Saddle	Insulation Shield	High-Density Insert
> 93 (200)	≥ 1-1/2	●	---	---
	≤ 1-1/4		●	---
61 to 93 (141 to 200)	> 6	●	---	---
	≥ 1-1/2 and ≤ 6	---	●	●
	≤ 1-1/4	---	●	---
26 to 60 (80 to 140)	≥ 1-1/2	---	●	●
	≤ 1-1/4	---	●	---
Cold & Dual Temp	≥ 1-1/2	---	●	●
	≤ 1-1/4	---	●	---

Table 4: Piping Insulation Protective Finishes			
Location	Weather Exposure	Piping System	Finish
Concealed	Indoors	All	None
Exposed	Indoors	All except steam over 860 kPa (125 psig)	PVC
	Indoors	Steam over 860 kPa (125 psig)	Fabric
	Indoors - painted pipe	All	Fabric
	Outdoors	All	Metal

END OF SECTION

START-UP AND PERFORMANCE TESTING REPORTING
20 08 01

1 GENERAL

1.1 Scope

.1 Performance testing and balancing of heating, ventilating, air conditioning and liquid systems.

.2 Survey of installed automatic controls and verification of functional performance.

1.2 Related work in other sections

.1 Air and water balancing: to section 20 08 05

.2 Factory testing, and calibrating of equipment or control systems.

1.3 Coordination

.1 Coordinate the work of testing companies:

.1 Schedule sufficient time so that testing and balancing can be completed before occupancy begins and coordinate with trades involved.

.2 Keep Testing and Balancing firm informed of any major changes made during construction and furnish same with a set of project drawings and reviewed Shop Drawings.

.3 Furnish balancing devices, test connections access openings, balancing probe inlets and plugs.

.4 Clean and pre-run all equipment, filters, etc. and place all heating, ventilating and air conditioning systems into full operation and continue same during each working day of testing and balancing.

.5 Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.

.6 Building Management System technical representative to operate the BMS during air and water balancing testing.

.7 Refrigeration machine manufacturer service representative conducts performance testing of the refrigeration equipment. Testing and Balancing Firm witnesses and records all test results.

.8 Fuel fired heating equipment manufacturer service representative, or other qualified service company technical representative, conducts performance testing of heating equipment. Testing and Balancing Firm witnesses and records all test results.

.2 Be responsible for systems constructed, installed and adjusted to provide optimum performance as required by design intent. Perform any re-adjusting required as the result of spot checks by the Consultant at no increase in Contract Price.

1.4 Submittals

.1 Submit layout drawings and Report Format a minimum 14 days prior to start of air and water balancing on-site.

.2 Report Format:

.1 submit proposed format of initial report,

.2 include a complete list of instruments and tests for which they are to be used as they relate to this project, including date of last calibration

2 PRODUCTS

2.1 Not applicable.

3 REPORT FORMAT

3.1 General

.1 Include the following information for each test report:

.1 Owner Name

.2 Project Name

.3 Contractor Name

.4 Consultant Name

.5 Name of Test Report

.6 Name and signature of the person submitting the report

.7 Date of report

.2 Submit two (2) copies of test reports in hardcopy form in 3-"D" ring binders, indexed for each type of report, separately bound from the Operations and Maintenance manuals. Provide two (3) copies of the same reports in Adobe Acrobat version 7 PDF forma.

4 START-UP AND PERFORMANCE REPORTS

4.1 Required reports

.1 Provide the following Start-Up and Performance Testing reports:

.1 Equipment start-up report

.2 Authorities report

.3 Air and water balancing report

.4 Acoustic survey report

.5 Vibration survey report

.6 Controls / BMS operation report

4.2 Equipment start-up report

.1 Provide a test report in spreadsheet format which summarizes the following data for each piece of equipment which is powered or has automatic controls:

.1 equipment ID and name,

.2 motor insulation megger test - result and initialed by contractor,

.3 motor rotation (bump test) - result and initialed by contractor,

.4 equipment Start-Up report status - status and initialed by contractor,

.5 manufacturer Start-Up report status – status and initialed by contractor,

.6 test completion date.

.2 Provide a test report in spreadsheet format which summarizes the following data for testing of piping systems:

.1 system name

.2 system limits (if system is not tested in its entirety),

.3 type of test (pneumatic, hydrostatic),

.4 pressure at start of test,

.5 pressure at end of test,

.6 duration of test,

.7 contractor dated and initialed,

.8 expansion tank initial pressure,

.9 expansion tank final pressure,

.10 backflow preventers have been tested - status and initialed by contractor,

.11 pressure relief valves installed – record setpoint and initialed by contractor.

.3 Equipment/System Start-Up Test Report

.1 Provide a separate start-up report for each piece of the following equipment. The SMACNA "Systems Ready to Balance Check List", where applicable, may be used for this report.

(a) HVAC Units
(b) Duct
Systems (c)
Pumps
(d) Boilers, and boiler auxiliaries
(e) Hydronic piping systems

.4 Manufacturer's Start-Up Test

.1 Provide a separate start-up report for each piece of the following equipment, utilizing the manufacturer's start-up check list. This report may be prepared by the manufacturer's service representative:

(a) chemical water treatment - pipe cleaning,
(b) chemical water treatment - passivating and
inhibition, (c) refrigeration equipment,
(d) packaged AC
equipment, (e) heating
boilers,
(f) steam
boilers, (g)
deaerators,
(h) packaged humidity steam
generators, (i) adjustable frequency
drives,
(j) Building Automation Systems.

4.3 Authorities review

.1 Submit copies of authorities-having-jurisdiction inspection and test reports, including:

.1 Plumbing and drainage municipal inspector reports

.2 TSSA pressure vessel and piping inspection reports

.3 ESA field certification reports

4.4 Air and water balancing

.1 Provide air and water balancing report: to Section 20 08 05.

4.5 Controls / Building Management System

.1 Provide controls test reports: to Section 25 08 00.

5 SPECIFIC EQUIPMENT PERFORMANCE TESTS

5.1 Performance data

.1 In addition to tests specified elsewhere, perform the following equipment performance tests. If contractor's standard forms provide for additional data, also submit such additional data.

.1 Some equipment tests may need to be performed during the alternate season testing.

.2 Include nameplate data and as-tested results.

.2 Water Chillers:

.1 peak kW power at peak tonnage load – at design condenser water and evaporator water temperature conditions,

.2 NPLV kW power at 0, 25, 50, 75 and 100% load, at design condenser water and evaporator water temperature, as per ARI 550/590-1998,

.3 IPLV kW power at 0, 25, 50, 75 and 100% load, as per ARI 550/590-1998,

.4 surge control setpoint at design condenser and evaporator water temperatures and flow,

.5 condenser water pressure differential/flowrate fault setpoint,

.6 evaporator water pressure differential/flowrate fault setpoint.

6 REPORT SUBMISSIONS

6.1 Deficiencies

.1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.

6.2 Draft report

.1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two (2) typewritten copies of a full report on all tests, adjustments, and balancing performed.

.2 Attachments including systems schematics with numbered terminals for referring to data above.

6.3 Spot checks

.1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30%

of all measurements in locations as directed by the Consultant, at no cost extra to the contract.

.2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

6.4 Interim report

.1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole "D" style binder, and two (2) CD or DVD electronic copies in Adobe Acrobat ver.7
PDF format.

.2 This report is required to obtain Substantial Performance of the Contract.

6.5 Final report

.1 Submit to Consultant following completion of alternate season testing and balancing. Submit three (3) typewritten copies, and two (2) CD or DVD Adobe PDF in the same formats as the initial report specified above.

6.6 Acceptance

.1 The Substantial Performance of the Mechanical Work will be considered reached when the interim Start-Up and Performance Testing report is reviewed by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

.2 The substantial performance is not dependent upon alternate season testing.

.3 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and reviewed by the Consultant.

END OF SECTION

TESTING ADJUSTING AND BALANCING
20 08 05

1 GENERAL

1.1 Scope

.1 Test, adjust, and balance (TAB) air handling systems and hydronic systems installed, modified or extended as part of this work.

1.2 Qualifications and performance standards

.1 Balancing to be performed under supervision of recognized expert with an established reputation in this field.

.1 TAB contractor to be a member of AABC or NEBB.

.2 Perform testing and balancing in accordance with:

.1 SMACNA Testing, Adjusting and Balancing guidelines,

.2 Associated Air Balancing Council standards for Total System Balance.

1.3 Preparatory work

.1 Review design drawings and specifications, shop drawings, interference drawings and other related documentation to become familiar with their intended performance.

.2 Carry out site visits during later stages of construction to ensure that arrangements for TAB are incorporated.

.3 Confirm proper placement of thermometer wells, test ports, pressure gauge cocks, balancing valves, balancing dampers and splitter dampers, and access doors.

.4 Submit TAB schedule, with descriptive data outlining procedures and sample forms showing method of data presentation, three months before start of TAB work on site.

.5 Provide details of specific procedures to be used for determining test parameters from test measurements and criteria proposed to establish compliance with specification requirements.

.6 List instruments to be used, method of instrument application (by sketch) and correction factors.

.7 Calibrate instruments in accordance with recognized standards, and submit calibration curves not more than three months before commencement of TAB.

.8 TAB measurements to commence when building is “closed in” and work is sufficiently advanced to include;

.1 Installation of ceilings, doors and windows.

.2 Application of sealing, caulking, and weather stripping.

.3 Normal operation of mechanical systems.

1.4 Systems, equipment and related controls requiring TAB

.1 Air handling systems.

.2 Hydronic systems including

.1 Heating and cooling equipment and piping systems.

.2 Domestic water equipment and cold, hot and recirculation hot water piping systems.

2 AIR MOVING SYSTEMS

2.1 Parameters

.1 Listed below is an outline of the information to be established in the TAB process:

.1 Air flow related; (a) Air velocity
(b) Flow cross sectional area. (c) Static pressure.
(d) Velocity pressure.

.2 Temperature related; (a) Wet bulb.
(b) Dry bulb.

.3 Equipment related;

(a) rotational speed (rpm) (b) Electrical power,
(c) Voltage.
(d) Current draw.

.2 Measurement are required at and around equipment to establish air side performance of;

.1 Fans.

.2 Coils.

.3 Filters.

.4 Dampers.(fresh, return and relief)

.5 Humidifiers.

.6 Terminal units

.3 Measurement are required to characterize system performance;

.1 at main ducts.

.2 at branch ducts.

.3 at sub-branch ducts.

.4 at each supply, exhaust and return air inlet and outlet.

.5 in each thermostatically controlled zone.

2.2 General criteria

.1 Balance systems so that fans operate at lowest possible speed and static pressure consistent with delivery of specified air quantity at most remote terminal point.

.2 Set-up supply fans with sufficient speed to deliver required air quantity when filters are

loaded to manufacturers recommended maximum pressure drop. Temporarily block filters to achieve maximum pressure drop at design air flow.

.3 Air quantities at each exhaust system inlet and supply system outlet are to be measured and throw and pattern is to be adjusted at each supply outlet.

.4 Balancing to be provided to all air outlets and inlets to airflow rates as indicated on plans.

2.3 Fan performance assessment

.1 Measure air quantity by taking anemometer traverses across a coil or at a filter bank or by pitot tube traverse in a straight section of duct at fan suction or discharge.

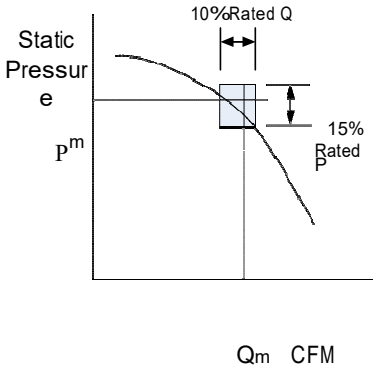
.2 Measure static pressure difference between fan inlet and discharge, motor amperage and fan speed in rpm. Determine motor input power from a curve showing power output as a function of motor amperage for the particular motor.

.3 Plot results of measurements on fan characteristic curve supplied by fan manufacturer and the air volume, static pressure and fan speed lines should form a triangle enclosed by a rectangle with a dimension of not more than 15% of the rated static pressure by a dimension of not more than 10% of the specified air quantity. Input power taken from the fan characteristic should be within 10% of the power determined from the motor amperage readings.

.4 If required precision is not obtained, readings to be repeated. If subsequent testing shows that the required precision is unobtainable then fan manufacturer is to submit written report explaining actual fan performance and provide new characteristic curve showing actual performance for fan “as installed”.

.5 Measure static pressure loss across cooling coils, heating coils and individual filter banks and tabulate readings with manufacturers published pressure loss figures for the actual measured air volume.

2.4 Variable volume system balancing procedure



.1 Obtain from Consultant the expected diversity value. Open sufficient boxes to 100%, and close a random selection of boxes, equally distributed throughout the system, to obtain the design fan flow rates.

.2 Set system to operate with 100% return air, set room thermostats at design indoor temperature, set fan discharge temperature at design point.

.3 Set thermostat in most remote zone to full cooling and adjust fan inlet guide vane, or AFD speed, static pressure control to supply specified air quantity at most remote zone volume damper, pneumavalve or terminal box.

.4 Reset most remote zone thermostat to design room temperature and set next most remote zone thermostat to full cooling and adjust branch splitter damper ahead of zone volume damper, pneumavalve or terminal box, to provide design air quantity at outlets.

.5 If zone air quantity is less than design, increase fan inlet guide vane, or AFD speed, static pressure control setting to achieve design air quantity and rebalance previously checked zones.

.6 Repeat as required for each zone.

2.5 Terminal box supply system balancing procedure

.1 Set system to operate with 100% return air, set room thermostats at indoor design temperature and set fan discharge temperature at design value.

.2 Set thermostat in most remote zone to full cooling and adjust fan inlet guide vane static pressure controller to maintain manufacturer's specified minimum static pressure at box inlet.

.3 Check air quantity delivered by box and adjust volume regulators to obtain design value.

.4 Reset room thermostat to full heating and check performance of regulator.

.5 Reset thermostat to design temperature and repeat procedure for remaining terminal boxes.

.6 If inlet static pressure at a subsequent box is less than manufacturer's specified minimum, reset inlet guide vane static pressure controller to suit.

.7 Open balancing dampers and adjust fan inlet static pressure controllers, or fan speed to obtain design air quantity at most remote outlet.

.8 Balance remaining outlets by adjusting dampers.

.9 If air quantity at some outlet other than the most remote outlet is less than design, re-adjust fan and rebalance previously adjusted outlets.

.10 Measure fan performance and adjust fan speeds and inlet guide vane controllers so that return air quantity is equal to supply air quantity less fixed exhaust air quantities, with a 10 percent allowance for pressurization.

2.6 Fresh air adjustment procedure

.1 After adjustment of supply, return and related exhaust fans, adjust minimum fresh air damper position to obtain design fresh air quantity.

.2 Damper position to be determined by measurement of outside return and mixed air temperatures and confirming calculations to be included in balance report.

.3 Where duct space permits, include airflow measurement of supply, and recirculation or outdoor air, to verify results.

2.7 Branch air quantity measurement procedure

.1 Branch air quantities to be determined using pitot tube traverses in accordance with the procedures outlined in "Testing, Balancing and Adjusting of Environmental Systems" by William G. Eads, P.E., issued by SMACNA.

.2 Measurements to be taken at each riser as it is connected to fan discharge or suction header and at each floor where branches are taken from the riser. Measurement to be repeated until sum of branch air quantities is within 10% of fan delivery.

3 HYDRONIC SYSTEMS

3.1 Parameters

.1 Listed below is an outline of the information to be established in the TAB process;

.1 Flow.

.2 Pressure.

.3 Temperature.

.4 Specific gravity.

.5 Rotational speed (rpm).

.6 Electrical

(a) power
(b) Voltage.
(c) Current draw.

.2 Measurement are required at and around equipment to establish fluid side performance of;

.1 Coils.

.2 Boilers.

.3 Pumps.

.4 PRVs.

.5 Makeup (water) systems.

.6 Domestic hot water heaters.

.7 Humidifiers.

3.2 General criteria

.1 Use calibrated venturi tubes, orifices or other metered fittings and pressure gauges in conjunction with permanent and portable type flow meters to determine flow rates for system balance.

.2 Effect system balancing with automatic control valves open to heat transfer elements and bypasses closed.

.3 Base flow balance on (in order of preference):

.1 double regulating valves, or globe valves associated with flow measuring elements (flow meters),

.2 temporary non-invasive flow meters,

.3 differential pressure measurement across heat transfer elements, and checked against manufacturer's literature, or

.4 temperature difference across various heat transfer elements in the system where flow metering devices are not installed. This method may only be used at design heat transfer conditions.

.4 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing.

.5 Perform balancing by measurement of temperature differential in conjunction with air balancing.

.6 Adjust water distribution systems by means of double regulating valves, globe valves, balancing cocks, valves and fittings. Do not use shut-off valves for balancing unless indexed.

.1 Butterfly valves on discharge side of pumps may be used if they are one trade size smaller than system pipe size. Include Cv values and flow vs valve position curve with balancing report.

.7 Where available pump capacity is less than total flow requirements of individual system parts, full flow in any part may be simulated by temporary restriction of flow to other parts.

4 EQUIPMENT TESTING

4.1 Performance data

.1 Submit the following data as a minimum. If contractor's standard forms provide for additional data, also submit such additional data.

.1 Some equipment tests may need to be performed during the alternate season testing.

.2 Include nameplate data and as-tested results.

.2 Hydronic Heating Equipment (Boilers, Heaters, etc):

.1 manufacturer and model,

.2 gas and fuel oil input flow rating,

.3 gas and fuel oil input pressure rating,

.4 gas pressure regulator inlet and outlet pressure,

.5 entering and leaving water temperature,

.6 entering and leaving water pressure,

.7 water flow rate,

.8 steam flow rate and pressure,

.9 combustion efficiency test at maximum rated capacity; including flue gas analysis,

.10 combustion efficiency test – as per Ministry of Environment Guideline A-9, corrected to 3% O2, for fuel input ratings exceeding 10 MMBtu/h (2932 kW),

.11 thermal efficiency, based on ASME short form power test code, for fuel input ratings exceeding 10 MMBtu/h (2932 kW).

.3 Motors:

.1 manufacturer,

.2 model or Serial number,

.3 amperage and voltage,

.4 horsepower,

.5 RPM,

.6 corrected full load amperage,

.7 measured amperage and voltage,

.8 calculated BHP (kW).

.4 Fans:

.1 manufacturer,

.2 model or Serial number,

.3 flow rate

.4 RPM,

.5 static pressures (suction and discharge),

.6 pulley size, type and manufacturer,

.7 belt size and quantity.

.5 Pumps:

.1 manufacturer,

.2 model or Serial number,

.3 flow rate,

.4 developed pump head,

.5 RPM.

5 REPORT PRESENTATION AND VERIFICATION

5.1 Required reports

.1 Provide the following reports:

.1 Air and water balancing report

5.2 Report format

.1 Reports to incorporate approved standard forms, with values expressed in SI and (Imperial) units.

.2 Include "as-built" system schematics showing flow quantities and measurement points. Use as-built drawings and ventilating line diagrams for references.

.3 Submit four hard copies of TAB reports, with index tabs, in "D" ring binders, for verification.

.4 Submit two soft copies of TAB reports in Adobe Acrobat V7 PDF format.

5.3 Accuracy

.1 Adjust systems until operating values within plus or minus 5% of design values are achieved.

.2 Measurements to be accurate to within plus or minus 2% of actual values.

5.4 Spot checks

.1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30%
of all measurements in locations as directed by the Consultant, at no cost extra to the contract.

.2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

5.5 Balance position marking

.1 Mark the balance position of dampers and valves at the completion of the final testing:

.1 Ductwork: indicate with arrow using paint or permanent marker,

.2 Exposed ductwork in public areas: self adhesive label, placed adjacent to balancing damper, neatly filled in with % open or degree open value.

.3 Valves: self-adhesive label, placed on piping (insulated or not) adjacent to valve, neatly filled in with either % valve open, or number of valve turns to open.

.2 Additional requirements for Double Regulating Valves:

.1 Remove valve handle or other protective device, and set memory stop to limit valve open travel.

Replace valve handle or protective cover.

5.6 Record keeping

.1 Keep records of trial and final balance and submit preliminary report as each system is completed.

.2 Make spot checks as requested and repeat balancing of system if actual spot check quantities do not agree with preliminary report figures.

5.7 Verification

.1 Reported measurements will be verified.

.2 Provide instrumentation and manpower to verify results of up to 30% of reported measurements.

.3 Number and location of verification measurements to be at discretion of Engineer.

.4 Where discrepancies are encountered repeat TAB, and resubmit reports.

5.8 Completion

.1 Continue TAB until reports are approved.

.2 The Substantial Performance of the Mechanical Work will be considered reached when the initial Start-Up and Performance Testing report is accepted by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

.3 The substantial performance is not dependent upon alternate season testing.

.4 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and accepted by the Consultant.

END OF SECTION

PROJECT CLOSE-OUT
MECHANICAL
20 08 19

1 GENERAL

1.1 Scope

.1 Provide documentation deliverables at completion of the Work.

1.2 Occupancy Permit

.1 Submit the reviewed final Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit.

1.3 Substantial Performance

.1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.

.2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.

.3 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.

.1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.

.4 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.4 Total Performance

.1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.

.1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.
- ☐ Equipment start-up reports (Interim).
- ☐ Building department inspection reports.
- ☐ TSSA pressure piping inspection reports (if applicable) TSSA fuel system field inspection reports (if applicable) ESA field inspection reports.
- ☐ Sprinkler installation certification report to NFPA 13. Standpipe installation certification report to NFPA 14.. Medical gas field inspection report and certificate.
- ☐ Air and Water Balancing reports (Interim). Acoustic survey report.
- ☐ Vibration survey report (if specified). Controls / BMS operation report.
- ☐ Equipment, pipeline, and valve identification completed
- ☐ Clean-up completed.
- ☐ Spare parts and replacement parts turned over to Owner; transmittal attached. Warranty certificates
- ☐ Operating and Maintenance Manuals, draft, submitted. As-built drawings submitted
- Training completed and attendance logs submitted.
- Commissioning reports submitted and reviewed by Consultant

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ Air and water balancing - final versions including alternate season testing completed and submitted. Final commissioning reports submitted and accepted by Owner.
- ☐ Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicate here)
- ☐ As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here)

Consultant Review	
Status:	□ Reviewed □ Incomplete or deficient - resubmit
Signed:	
Date:	

END OF SECTION

FIRE PROTECTION - GENERAL
21 05 01

1.1 GENERAL

1.2 Scope

.1 Fire protection work includes;

.1 Commissioning of fire protection systems,

.2 Standpipe & Hose Systems

.3 Fire Extinguishers

.4 Wet Pipe Sprinkler System

1.3 Applicable Codes and Standards

.1 Fire Protection Work to conform to Standards of National Fire Prevention Association (NFPA) and relevant sections of The Ontario Building Code.

1.4 Water supply test results

.1 Provide water flow test on municipal water service in proximity to building connection, in accordance with NFPA 14 and NFPA 291. Flow test must be conducted within one (1) year prior to system design. Submit record of test including static pressure, and residual pressure and flow.

.2 Obtain municipal approval and pay fees associated with testing

.3 Water supply flow test data:

Static pressure, kPa :	
Flow rate, L/s :	
Residual pressure, kPa :	
Contractor name:	
Date of Test:	
Street main size, NPS	
Location of hydrant	

2 PRODUCTS

2.1 Pipe, hangers and gaskets

.1 Pipe:

.1 ASTM A53 Grade B, Schedule 40 continuous weld steel to up to NPS 2, grooved or screwed. (a) Galvanized where specified.

.2 ASTM A53-63R Grade B, Schedule 40 electric resistance weld steel for NPS 2½ to NPS 10, welded.

.3 NPS 2½ and over ASTM A53-72A Schedule 10 thin wall, rolled grooved.

.2 Pipe hangers:

.1 UL/ULC listed for fire protection, and

.2 swivel ring hanger type or

.3 as specified in Section 20 05 29 Hangers and Supports.

.3 Gaskets for flanged joints:

.1 Red rubber sheet 1.6 mm (1/16 in) thick.

Standard of Acceptance
- Chesterton 100
- Beldam Red Rubber

2.2 Fittings, and valves up to 1200 kpa (175 psi) working pressure

.1 Fittings:

.1 1035 kPa (150 #) black malleable iron screwed up to NPS 2.

.2 Forged steel, butt welding Schedule 40 for NPS 2½ and over.

.2 Unions:

.1 1035 kPa (150 #) black malleable ground joint union, bronze to iron seat up to NPS 2.

.3 Flanges:

.1 1035 kPa (150 #) forged steel, slip-on or weld neck, raised face style.

.4 Valves:

.1 ULC and FM listed for fire protection service.

.2 as specified in Section 20 10 00 Valves.

2.3 Fittings for grooved pipe up to 1200 kpa (175 psi)

.1 Couplings:

.1 Malleable or ductile iron NPS 2½ and over.

.2 Fittings:

.1 Malleable iron or ductile iron to NPS 2½ to NPS 12.

.3 Flanges:

.1 Cast iron, raised face flange with coupling groove NPS 2½ and over.

.4 Gaskets for grooved couplings:

.1 EPDM Grade "E", dry lubricated.

3 EXECUTION

3.1 Piping Installation

.1 General layout of mains, risers, run-outs and connection details of piping systems are shown.

.2 Provide bends, expansion loops, hoses or joints to compensate for pipe seismic movement.

.3 Anchor, guide and laterally support vertical and horizontal piping to support filled weight and absorb thrust under operating conditions.

.4 Erect piping so that gravity forces and thrust from changes in direction do not stress connections to apparatus.

.5 Separate copper pipe and fitting materials from contact with ferrous material with di-electric couplings.

.6 Install drain valves at low points in water piping systems and in valved run-outs from risers so that system or isolated parts of system can be drained.

.7 Do not use galvanized materials in contact with glycols.

3.2 Existing Conditions

.1 Contractor shall verify in the field the existing conditions before proceeding with work.

.2 Contractor shall coordinate the work will all trades and existing conditions.

.3 Verify in the field location of existing fire standpipe and/or sprinkler risers.

.4 Locations and sizes of existing piping are approximate. Field verify exact sizes and locations of all existing piping at the site.

3.3 Coordination

.1 Provide a fire watch for the duration of all sprinkler system shut-downs. Restore sprinkler system to active conditions when the fire watch is not provided. Coordinate scheduling with Building Management.

.2 Coordinate piping slab penetration locations with Owner.

.3 Refer to architectural/designer drawings for all ceiling heights.

.4 The contractor shall include in the price the cost for draining and filling the existing sprinkler system in order to facilitate the sprinkler scope of work.

.5 Future connections to be provided for Phase 2 and Phase 3 scope of work.

.6 Installation of sprinkler ring main to be coordinated with existing services. Where required, existing services shall be relocated in order to facilitate installation of mains at high level tight to underside of slab.

END OF SECTION

FIRE EXTINGUISHERS 21 12 29

1 GENERAL

1.1 Scope

.1 Provide extinguishers as shown.

1.2 Applicable standards

.1 National Fire Protection Association (NFPA) 10 Standard for Portable Fire Extinguishers.

2 PRODUCTS

2.1 Pressurized water extinguishers

.1 Stored pressure type, squeeze-grip operated of stainless steel construction, ULC labeled, 9.1 L (2 gal) size, 2-A rating.

Standard of Acceptance
- National Fire Equipment Ltd. - Model WBDL-W2.5
- Flag Fire Equipment Ltd - Model PWS-25-F

2.2 Multipurpose dry chemical extinguishers

.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection, red enamel finish. Sizes 1.25 kg (2¾ lb), 2.25 kg (5 lb), 4.5 kg (10 lb), 9 kg (20 lb), 12.7 kg (27 lb) as indicated.

.2 Provide 1.25 kg (2 ¾ lb) size if not otherwise shown.

Standard of Acceptance
- National Fire Equipment Limited - ABC
- Flag Fire Equipment Limited - ABC

2.3 Ordinary dry chemical extinguishers

.1 Stored pressure type with hose and shut-off nozzle, ULC labeled for B and C class protection, glossy enamel finish. Sizes 1.25 kg (2¾ lb), 2.25 kg (5 lb), 4.5 kg (10 lb), 9 kg (20 lb), 14 kg (30 lb) as indicated.

.2 Provide 1.25 kg (2¾ lb) size if not otherwise shown.

Standard of Acceptance
- National Fire Equipment Limited - PDC
- Flag Fire Equipment Limited - PDC

2.4 Carbon dioxide extinguishers

.1 Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze-grip operation, fully charged, ULC labeled for B and C class protection, glossy baked enamel finish. Sizes 2.25 kg (5 lb), 4.5 kg (10 lb), 6.75 kg (15 lb), and 9 kg (20 lb) as indicated.

.2 Provide 2.25 kg (5 lb) size unless otherwise shown.

Standard of Acceptance
- National Fire Equipment Limited - CO2
- Flag Fire Equipment Limited - CO2

2.5 Extinguisher cabinets

.1 Recessed, surface mounted or semi-recessed type as indicated.

.2 Constructed of 1.6 mm (16 ga) steel.

.3 180° opening door of 2.5 mm (12 ga) steel with latching devices and 5 mm (3/16 in) full glass panel.

2.6 Identification of extinguishers

.1 Include bilingual tag or label attached to extinguishers, in accordance with recommendations of NFPA 10, indicating month and year of installation, with space for service dates.

3 EXECUTION

.1 Mount cabinets and brackets.

.2 Install extinguishers at project completion. Confirm location with local building or fire department prior to installation.

END OF SECTION

WET PIPE SPRINKLER SYSTEM
21 13 13

1 GENERAL

1.1 Scope

.1 Provide wet pipe automatic sprinkler systems.

.2 Provide installation drawings and hydraulic calculations, designed and sealed by a professional engineer licensed in the province of Ontario.

1.2 Qualified Subcontractors

.1 Sprinkler work to be undertaken by specialist automatic sprinkler installation firm with an established reputation in this field.

1.3 Applicable codes and standards

.1 National Fire Protection Association (NFPA) 13 - Standard for the Installation of Sprinkler Systems

.2 NFPA 25 - Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

.3 Ontario Building Code

.4 Ontario Fire Code

.5 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless

.6 CSA B64 - Backflow Preventers and Vacuum Breakers

1.4 Shop drawings and product data

.1 Prepare shop drawings and forward three copies with hydraulic calculations to Owners Insurers for review and acceptance.

.2 After shop drawings are accepted by reviewing Authority submit copies of these stamped shop drawings and product data sheets for review in accordance with Division 1 procedures.

1.5 Samples

.1 Submit samples of;

.1 sprinkler heads,

.2 signs.

1.6 Design criteria

.1 System is designed to NFPA 13 using hydraulic method for hazard classification shown with design densities and design areas for each zone as detailed.

.2 Hydraulic calculations are based on water supply test results, down-rated in accordance with requirements of Authorities having jurisdiction as shown. Hydraulic calculations establishing pipe sizing as shown on drawings are available upon request.

.3 Changes to pipe sizes or head layouts accompanied with modified hydraulic calculations, may be submitted for approval.

1.7 Maintenance materials

.1 Provide cabinet, containing special sprinkler wrench, and spare stock of sprinklers. Include at least one head of each type and temperature rating installed in system.

2 PRODUCTS

2.1 Pipe, hangers and gaskets

.1 To section 21 05 01.

2.2 Sprinkler heads

.1 Ratings:

.1 ULC and FM listed for fire service.

.2 standard temperature rating 57°C to 74°C (135°F to 165°F) with intermediate or high temperature rating to suit local conditions.

.3 thermal sensitivity:

(a) Quick Response type for Light and Ordinary hazard applications
(b) Standard response type for Extra hazard applications.

.2 Selection:

.1 indicated by type in accordance with following:

(a) TYPE U-1 upright bronze body with 12 mm (½ in) diameter orifice or 13 mm (17/32 in) diameter orifice as shown.
(b) TYPE P-1 pendent, recessed, chrome plated adjustable escutcheon body ring and cup, glass bulb type.
(c) TYPE P-2 pendent, flush, concealed with fusible chrome or white cover plate, glass bulb type.
(d) TYPE W-1 side wall, chrome plated and chrome escutcheon plate, link and lever type.

Standard of Acceptance
- Viking
- Tyco
- Reliable
- Victaulic

.3 Contractor shall allow for additional sprinkler heads (10% of total new sprinkler heads per floor) not indicated on plans to accommodate field conditions.

2.3 Alarm check valves

.1 Construction:

.1 ULC and FM listed for fire service,

.2 resilient seat swing check valve,

.2 Trim:

.1 include valves, gauges, fittings and nipples for;

(a) drain connections,
(b) alarm connection,
(c) alarm test,
(d) pressure switch to indicate low pressure in system, wired to sprinkler trouble annunciator. (e) excess pressure pump connections
(f) alarm pressure switch wired to sprinkler annunciator.
(g) pressure gauges to show water and air pressures with combined SI and Imperial scales.

Standard of Acceptance
- As listed above for sprinkler heads

2.4 Ancillary devices

.1 Supervisory switches:

.1 ULC and FM listed for fire service,

.2 mechanically secured, with N.O. and N.C. contacts and supervisory capability,

.3 for OS & Y gate valves.

Standard of Acceptance
- Potter Electric - Model OSYSU - for post indicator and butterfly valves

Standard of Acceptance
- Potter Electric - Model PCVS

.2 Pressure switches on alarm check valves:

.1 for loss of normal water pressure on wet sprinkler system,

.2 for monitoring of low water pressure on wet sprinkler system with excess pressure pump.

Standard of Acceptance
- Potter Electric - Model PS100-21: for detecting water flow alarm condition

Standard of Acceptance
- Potter Electric - Model PS120A: for monitoring low water pressure

.3 Flow indicators:

.1 For mounting in zone piping.

.2 Fitted with;

(a) sealed retard,
(b) visual indication of switch activation,
(c) mechanical delay adjustment

Standard of Acceptance
- Grinnell - F-620
- Potter Electric - VS
- System Sensor - WFD

.4 Water gong:

.1 Water operated outside alarm bell, weather protected.

Standard of Acceptance
- As listed above for sprinkler heads

2.5 Signs

.1 Type:

.1 fitted on control valves, shut-off valves, drain valves and test valves,

.2 150 mm x 150 mm (6 in x 6 in) for automatic control valves and alarm valves,

.3 50 mm x 150 mm (2 in x 6 in) for other valves, and

.4 made of enameled steel with fire department red enamel background, white letters, inscription in accordance with NFPA Standards.

2.6 Sprinkler control cabinets

.1 Construction:

.1 765 mm (30 in) high, 765 mm (30 in) wide and 305 mm (12 in) deep, flush type with 1.6 mm (16 ga) steel tub, 2.5 mm (12 ga) metal door, and 2.5 mm (12 ga) flush adjustable plaster trim with full rebate for door,

.2 fully concealed, 180° opening door hinges and corbin latch with lock of flush cast construction,

.3 interior surfaces of cabinet prime painted with final finish provided under Finishes, Division 9,

.4 fitted with alarm test module consisting of rising stem bronze globe valve having integral orifice and drain port and sight glasses, and

.5 identified by red lettered sign: "X FLOOR, "Y" ZONE SPRINKLER SHUT-OFF VALVE. DRAIN AND TEST".

Standard of Acceptance
- Victaulic - "TestMaster II", Style 720 with threaded or grooved ends.

2.7 Double check valves and backflow preventers

.1 ULC and FM listed for fire service.

.2 double check valve assemblies and reduced pressure backflow preventer assemblies to be in accordance with CSA B64

Standard of Acceptance
- Hersey
- Watts

2.8 Hand hose assemblies

.1 30 m (100 ft) of 40 mm (1½ in) diameter unlined linen hose on rack with hydrolator, 1½ NPS angle valve and chrome plated combination fog, solid stream and shut-off nozzle.

Standard of Acceptance
- National Fire Equipment - Model RU-30
- Wilson & Cousins - Model IE-9

3 EXECUTION

3.1 General

.1 Provide headers, alarm check valve assemblies, valves, and fire department connections.

.2 Provide supervisory switches on valves.

.3 Provide water flow alarm switches, and two low water pressure monitoring switches.

- .1 one low water pressure switch to operate excess pressure pump
- .2 one low water pressure switch to annunciate trouble condition to fire alarm system, set at 70 kPa (10 psig) below excess pressure pump start setpoint - field verified.

.4 Provide signs at each valve identifying portion of system controlled. Fasten signs to pipe in immediate vicinity of valve.

.5 Install excess pressure pump across alarm valve.

.6 Extend piping through and connect to sprinklers.

.7 Wiring of trouble and flow alarms from alarm check valves will be done under Electrical Division 26 .

.8 Provide drain valves at trapped low points in piping system.

.9 Provide additional sprinkler heads with associated piping for sprinkler protection under ducts, under obstructions, and in blind spaces. Identify additional sprinkler heads on shop drawings with capital letter "A" and resubmit drawings to permit inclusion of these sprinkler heads in hydraulic calculations.

.10 Combination drains or hub drains will be provided at headers and control cabinets under Division 22.

.11 Run NPS 2 drain through wall to outside for Inspectors water flow testing in locations shown.

.12 Personnel involved in installation of grooved joint piping and fittings to be conversant with;

- .1 pipe end preparation and special tools,
  - (a) pipe ends to be clean and free from indentations, projections and roll marks in area from pipe end to groove.
  - (b) dimensions to be according to standard cut groove or roll groove Specification (Victaulic TS-215/78).
- .2 coupling and fitting selection.
- .3 joint assembly to accommodate expansion, contraction, and flexibility,
- .4 specifications and/or recommendations with respect to support, anchorage and guiding of pipe systems.

3.2 Backflow protection

.1 Isolate automatic sprinkler system from potable water supply in accordance with the Ontario Building Code.

3.3 Freeze protection piping

.1 Provide antifreeze loops, with shut off and test valves and filling arrangements and charge with 40%

water and 60% propylene glycol.

.2 Provide a reduced pressure principle backflow preventer to isolate the antifreeze loop from the remainder of the sprinkler piping system.

.1 Gravity loops are not acceptable for backflow protection.

3.4 Sprinkler selection

.1 Use pendant sprinklers where suspended ceilings occur. Locate sprinklers in symmetrical pattern to suit reflected ceiling plans and to avoid speakers, fire alarm components, lighting fixtures, ductwork and diffusers. In general, centre heads in ceiling tiles.

3.5 Testing and approvals

.1 Test sprinkler systems in accordance with requirements of NFPA.

.2 In existing buildings, for new additions to an existing sprinkler system: in addition to the NFPA requirements for pressure testing, conduct an initial pressure test:

.1 isolate the new piping from the existing system,

.2 pressure test the new piping at 350 kPa (50 psig) using oil-free compressed air or nitrogen,

.3 maintain pressure test for one hour without loss of pressure,

.4 if any leaks are discovered, repair leaks and retest.

.3 Schedule testing to give at least two weeks' notice to following authorities:

.1 Local Building/Plumbing Inspector,

.2 Local Fire Department Representative,

.3 Insurer's Representative,

.4 Owner, and

.5 Consultant.

.4 Prior to testing, ensure that valves, flow switches, pressure switches, supervisory switches and other devices are functioning.

.5 Provide Contractor's Material and Test Certificate for above ground piping.

.6 Distribute copies of Certificates as per shop drawing requirements.

.7 On completion of project obtain Certificate of Approval showing that work is in accordance with rules and regulations of National Fire Protection Association.

END OF SECTION

PLUMBING GENERAL
22 05 01

1 GENERAL

1.1 Scope

.1 Provide labour, materials and equipment for installation, testing and putting into operation plumbing and drainage systems.

1.2 Qualified tradesmen

.1 Work to be done by qualified and recognized firm with an established reputation in this field using tradesmen holding certificates of competency.

1.3 Applicable codes and standards

.1 Ontario Building Code

.2 Regulations of Province, City, or local authority having jurisdiction.

.3 CSA B272 Pre-Fabricated Self Sealing Roof Vent Flashings

.4 AWWA C651, Disinfecting Water Mains.

.5 O.Reg. 212/01 Gaseous Fuels, and related code adoption document.

.6 O.Reg. 215/01 Fuel Industry Certificates

.7 CSA B149.1 Natural Gas and Propane Installation Code

1.4 Qualifications

.1 Contractors performing work on natural gas or propane systems to be licensed as a gas and propane installer under O.Reg. 215/01, by the Technical Standards and Safety Authority.

2 PRODUCTS

2.1 Flashing

.1 Through-roof penetration flashing, and other waterproofed areas:

.1 manufactured from composite material in accordance with CSA B272,

.2 minimum dimensions of 500 mm x 500 mm (20 in x 20 in),

.3 with sleeve extending at least 150 mm (6 in) above roof.

3 INSTALLATION

3.1 Piping

.1 Piping system routing is shown diagrammatically. Locate mains, risers and runouts concealed behind furrings or above ceilings except in mechanical equipment rooms and

access spaces where piping is to be exposed.

.2 Determine areas without ceilings from Architectural Drawings and Room Finish Schedules, and in these areas keep piping as high as possible.

.3 Anchor, guide and support vertical and horizontal runs of piping to resist dead load and absorb thrust.

.4 Coordinate routing of all piping with ducts and light fixtures.

.5 Contractor shall coordinate slab penetrations with Building Engineer.

3.2 Domestic cold water system distribution

.1 Provide domestic cold water system with

.1 distribution pipe and fittings,

.2 valves,

.3 premises backflow isolation,

.4 zone or equipment backflow protection.

.2 Minimum water pressure at street level: approximately 500 kPa (70 psi).

.3 Provide valved connections from supply system, to fixtures and other equipment requiring cold water.

3.3 Domestic hot water system distribution

.1 Provide domestic hot water system with

.1 distribution pipe and fittings

.2 valves

.3 zone or equipment backflow protection.

.2 Provide cold water connections to hot water tank, with shut-off and check valve on supply and valved drain at bottom of tank. Drill check valve disc with 1.6 mm (1/16 in) hole in its centre.

.3 Provide valved connections from hot water supply system to fixtures and other equipment requiring hot water.

3.4 Domestic hot water recirculation system

.1 Provide domestic hot water recirculation system with

.1 distribution pipe and fittings

.2 valves

.3 pumps

.2 Connect ends of hot water risers to recirculation mains and extend to recirculation pump.

.3 Install recirculation piping as shown.

3.5 Drainage

.1 Provide roof drains and storm drainage piping system.

.2 Provide waste and vent connections to plumbing fixtures and equipment.

.3 Fittings;

.1 Do not use double hubs, straight crosses, double T's, or double TY's in soil or waste pipe below any fixture.

.2 Do not use branch fittings other than full "Y" or "Y" and an eighth bend, on soil or waste pipe running in horizontal direction.

.3 Do not use quarter bend placed on its side.

.4 Do not use inverted joints below fixtures.

.5 Do not install cleanouts above food preparation or patient treatment areas. In these areas carry rodding connection up to floor cleanout fitted with adjustable gasketted access cover and plug, with cleanout body cast in floor slab above.

.6 Drainage fittings to match connected piping for quality and wall thickness.

3.6 Special water and waste connections

.1 Provide hot and cold water, waste and vent connections to equipment.

.2 Provide vacuum breakers and backflow preventers on equipment connections, and hose bibbs, and on fixture connections without adequate air gaps.

.3 Where hot and cold water supply pipes connect to combination supply fitting with shut-off valve on discharge, or where combination supply fitting is equipped with manual or thermostatic mixing valve, equip each hot and cold water supply pipe with composition disc swing check fitting.

.4 Provide shut-off valve on each service line close to apparatus and brass trap complete with cleanout on waste connection unless waste discharges directly into floor drain or funnel drain.

.5 Where specific sizes are not shown, valves, and final connections to equipment to be one pipe size larger than equipment tapping size, and trap and drain size to be one pipe size larger than waste connection on apparatus.

.6 Provide similarly sized connections for items marked N.I.M.C. (Not in Mechanical Contract) and S.B.O. (Supplied by Owner).

.7 For these items:

.1 N.I.M.C. Do not make final connections but provide services.

.2 S.B.O. Make final connections including traps, screwdriver stops and accessories.

3.7 Flashing

.1 Provide flashing for piping penetrations through roofs and other waterproofed areas. Leave flashing ready for Roofing or Waterproofing Trades to make watertight connections.

3.8 Vent termination (VTR)

.1 Fit vents passing through roof with vent stack sleeve terminating not less than 150 mm (6 in) above roof, above flood level of roof, and 900 mm (3 ft) above or 3500 mm (11.5 ft) horizontally from any air intake, door, or operable window.

3.9 Flushing and Cleaning - Building Water Distribution Piping

.1 Conduct first fill and pressure testing of building distribution piping only after completion of flushing and disinfection of water service pipe.

.2 Complete piping pressure tests prior to flushing and cleaning operations.

.3 Flush water distribution piping through available outlets with sufficient flow to produce velocity of 1.5 m/s, within pipe for 10 minutes, or until foreign materials have been removed and flushed water is clear.

.4 Minimum flushing flowrates:

Pipe size	Minimum Flow	
NPS	L/s	usgpm
2	3.3	52
2 1/2	4.7	75
3	7.3	115
4	12.6	200

.5 Open and close valves, hydrants and service connections to ensure thorough flushing.

END OF SECTION

PLUMBING SPECIALTIES & ACCESSORIES
22 05 23

1 GENERAL

1.1 Scope

.1 Provide plumbing specialties and accessories.

1.2 Product data

.1 Submit product data sheets for;

.1 Floor drains, roof drains, cleanouts, wall hydrants, water hammer arresters, back flow preventers, back water valves, hose bibbs, water make-up assembly, pressure reducing stations, pressure reducing valves, strainers, grease interceptors, traps.

1.3 Applicable codes and standards

.1 CSA-B125 Plumbing Fittings.

.2 CSA B.64.1.1 Vacuum Breakers, Atmospheric Type

.3 CSA B.64.4 Backflow Preventers, Reduced Pressure Principle Type

.4 CSA B64.10 Manual for the Selection and Installation of Backflow Prevention Devices/Manual for the Maintenance and Field Testing of Backflow Prevention Devices

.5 CSA B79 Floor, Area, and Shower Drains and Cleanouts for Residential Construction

.6 Plumbing and Drainage Institute (PDI) Standard PDI-WH201.Water Hammer Arresters

.7 PDI-G101 Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.

2 PRODUCTS

2.1 General

.1 Floor, area, combination and roof drains and cleanouts to conform to CSA B79 and to be products of one manufacturer.

Standard of Acceptance
- Jay R. Smith
- Mifab
- Zurn

2.2 Floor drains

.1 Construction:

.1 cast iron body

.2 integral double drainage openings, flashing ring and clamping device.

.3 polished nickel bronze adjustable strainer.

.4 integral flange to receive the floor finish.

.5 adjustable galvanized ductile iron tractor grates in mechanical equipment rooms and fan rooms.

Standard of Acceptance
- Jay R. Smith 2005 series
- Mifab F1100 series
- Zurn Z-415 series

2.3 Area drains

.1 As specified for floor drains in mechanical rooms.

Standard of Acceptance
- Jay R. Smith 2320 series
- Mifab F1320 series
- Zurn Z-538

2.4 Cleanouts

.1 In floors:

.1 line size for NPS 2, NPS 3 and NPS 4 and NPS 4 in larger lines.

.2 seal and test plug

.3 cast iron body with clamp and collar,

.4 in unfinished floor areas,

(a) cast iron frame heavy duty scoriated cast iron round or square tractor cover and internal plug, and

.5 in finished flor areas,

(a) nickel bronze frame and round or square nickel bronze adjustable access cover, (b) recessed for tile infill in tiled areas,
(c) recessed for carpet infill in carpeted areas,
(d) deeply recessed for terrazzo infill in terrazzo finished areas, and with
(e) extended flange around frame in areas with monolithic floor finishes.

Standard of Acceptance
- Jay R. Smith 4000 series
- Mifab C1100 series
- Zurn Z-1400 series

.2 In exposed areas, ceiling spaces and accessible pipe chases,

.1 cast iron caulking ferrule with neoprene jacket and plug secured to body with cap screws.

2.5 Water hammer arresters

.1 Stainless steel construction with precharged air chamber of nesting bellows.

.2 Selected in accordance with Plumbing and Drainage Institute Standard PD1-WH201.

Standard of Acceptance
- Jay R. Smith Hydrotrol 5000 series
- Mifab WHB series
- Zurn Shocktrol Z-1700 series

2.6 Trap seal primers

.1 Serving 1 to 4 drains:

.1 electric, manifolded units,

.2 components factory assembled in 1.5 mm (16 ga) recessed metal cabinet with hinged stainless steel lockable access door,

.3 atmospheric vacuum breaker,

.4 preset 24 hr clock,

.5 manual over ride switch,

.6 120 Volt solenoid valve,

.7 NPS ¾ or NPS ½ valved inlet water connection,

.8 calibrated water distribution manifold,

.9 NPS ½ outlet compression fittings.

Standard of Acceptance
- Precision Plumbing Products Model PTS-4

2.7 Back-flow preventers - Reduced Pressure Principle (RP)

.1 Conforming to CSA B.64.4

.2 NPS 3/4 and larger:

.1 two independent check valves with intermediate relief valve,

.2 OS&Y ULC listed resilient seated gate valves,

.3 ball test cocks, and

.4 air gap drain.

Standard of Acceptance
- Watts No.909 series
- Cla-val Company Model RP-1
- Conbraco 40200 & 40100 Series

.3 NPS ¼ and ½:

.1 two independent check valves with intermediate relief valve,

.2 quarter turn full port resilient seated ball valves,

.3 inlet strainer,

.4 ball test cocks, and

.5 air gap drain.

Standard of Acceptance
- Watts No.909QT series

2.8 Vacuum breakers

.1 Conforming to CSA B.64.1.1.

.1 NPS ¼ to 3:

(a) atmospheric type (AVB), with single float and disc, and

(b) large atmospheric port.

Standard of Acceptance
- Watts No.288A series
- Cash Acme Type V-101

.2 NPS ½ to 2:

(a) pressure type (PVB) with spring loaded single float and disc,
(b) independent first check, shut off valves, and ball type test cocks.

Standard of Acceptance
- Watts No.800 series

.2 Conforming to CSA B.64.2

.1 NPS ¾,

(a) Hose connection type (HCVB) with non-removable single check, and
(b) atmospheric vent vacuum breaker.

Standard of Acceptance
- Watts No.8A
- A.W.Cash Valve Type V-3

2.9 Backflow Preventer Valve Cabinets

.1 Recessed mount:

.1 stainless steel with No. 4 satin polish finish,

.2 1.2 mm (16ga) welded one piece tub with adjustable face frame,

.3 solid door with rounded safety cornered door, continuous exposed piano hinge and cam latch,

.4 integral 50mm (2") high drain pan at bottom of tub, sloping to a NPT 1" center drain outlet,

.5 hole punching for piping penetrations as shown.

.6 Cabinet size:

(a) single valve : 826mm x 762mm x 152mm (32 ½" x 30" x 6") deep
(b) double valve: 826mm x 1219mm x 152mm (32 ½" x 48" x 6") deep

Standard of Acceptance
- Acudor #BFP-1 for single valves
- Acudor #BFP-2 for double valves

2.10 Water make-up assemblies

.1 Iron body water pressure regulator with;

.1 integral check,

.2 stainless steel strainer,

.3 fast fill /purge lever, and

.4 Iron body diaphragm operated relief valve

Standard of Acceptance
- Watts No.1450F series
- A.W.Cash Valve Type CBL

- Conbraco

2.11 Pressure reducing valves

.1 Self-contained type with;

.1 bronze body,

.2 single renewable nickel alloy seat and resilient disc,

.3 diaphragm suitable for 90°C (200°F) service,

.4 close coupled bronze strainer with stainless steel screen.

Standard of Acceptance
- Watts
- A.W.Cash Valve
- Singer Valve
- Leslie
- Fisher Controls
- Spence ED Series
- Conbraco

2.12 Strainers

.1 "Y" pattern with;

.1 bronze, cast iron or steel bodies ,

.2 screwed or flanged to match pressure class and size restrictions specified for globe valves in section of piping system where strainer is to be installed,

.3 stainless steel baskets with;

(a) 0.8 mm (1/32 in) diameter perforations for strainers up to NPS 3 size and
(b) 3.2 mm (⅛ in) diameter perforations for strainers NPS 4 and larger.
(c) Baskets with 3.2 mm (⅛ in) diameter perforations to be made from 0.9 mm (0.037 in) stock reinforced with 13 mm x 0.9 mm (½ in x 0.037 in) bands of the same material spot welded to baskets

3 EXECUTION

3.1 Installation general

.1 Install to conform with Canadian Plumbing Code, provincial codes, and local authority having jurisdiction.

3.2 Cleanouts

.1 Install at base of soil and waste stacks, and rainwater leaders and at changes in direction.

.2 Extend cleanouts flush to wall or finished floor unless serviceable from below floor.

.3 Install cleanouts located in floors clear of obstructions.

3.3 Water Hammer Arresters

.1 Select and install in accordance with PDI-WH 201 on branch supplies to each fixture or group of fixtures.

3.4 Trap seal primers

.1 Select and install to prime floor and funnel drain traps.

.2 120V 1ph 60 Hz supply will be brought to electric manifolded units under Division 26 and connected under Division 22.

3.5 Back-flow preventers and vacuum breakers

.1 Install in accordance with CSA B64.10.

.2 Install backflow preventers horizontally, in accordance with manufacturer's recommendations, but not less than 300 mm (12") and not greater than 1500 mm (60") above the floor.

.3 Pipe discharge from backflow preventer, with air gap, to nearest drain or service sink.

3.6 Water make-up assemblies

.1 Pipe discharge from relief valve to nearest floor drain.

3.7 Pressure reducing valves

.1 Install with shut-off valve upstream and 115 mm (4½ in) pressure gauge downstream.

3.8 Strainers

.1 Install with sufficient space to remove basket.

END OF SECTION

DOMESTIC WATER SUPPLY PIPING - COPPER
22 11 16

1 GENERAL

1.1 Scope

.1 Provide copper pipe and fittings for potable domestic water piping, above and below ground.

1.2 Applicable codes and standards

.1 ASTM B88 Standard Specification for Seamless Copper Water Tube

.2 ASME B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250

.3 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

.4 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.5 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings; Class 150, 300, 400, 600, 900, 1500, & 2500.

.6 ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

.7 CSA B242 Groove and Shouldered Type Mechanical Couplings

.8 AWS A5.8 Brazing Filler Metal.

.9 AWWA C606 Grooved and Shouldered Joints

.10 AWWA C111/ ANSIA21.11 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

.11 ASTM A307 Standard Specification for Carbon Steel Bolts and Studs 60,000PSI Tensile Strength

.12 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

.13 ASTM B-32 Specification for Solder Metal

2 PRODUCTS

2.1 Domestic hot, cold and recirculating piping, within building

.1 Copper tube: to ASTM B88.

.1 Hard drawn, type L above ground.

.2 Soft annealed, type K below ground.

.2 Tube to have certification markings made by testing agency accredited by Standards Council of Canada.

2.2 Fittings

.1 Brass or bronze flanges and flanged fittings: to ASME B16.24.

.2 Brass or bronze threaded fittings: to ASME B16.15.

.3 Solder/brazed fittings: cast bronze to ASME B16.18, or wrought copper and bronze to ASME B16.22.

.4 Roll groove full flow standard radius cast bronze fittings for sizes NPS 2 1/2 and larger: to AWWA C606.

2.3 Joints

.1 Flanged joints:

.1 made up with rubber gaskets 1.6 mm ($^1/_{16}$ in) thick to AWWA C111 and

.2 heavy series bolts, hexagonal head pattern to ASTM A307, nuts to ASTM 563, and washers.

.2 Solder: tin antimony solder, 95:5 to ASTM B-32.

.3 Silver brazing alloy AWS Classification BCUP-5

Standard of Acceptance
- Handy Harman "SIL-FOS"
- All-State Welding Alloys "SILFLO 15"

.4 Roll grooved piping:

.1 made up with roll groove positive clamp gasketted couplings or roll groove flange adapters for copper piping to CSA B242 or AWWA C606.

Standard of Acceptance
- Victaulic
- Gruvlock
- Couplox
- Shurjoint

2.4 Valves

.1 Valves: to Section 20 05 23 Valves.

3 EXECUTION

3.1 Installation

.1 Isolate equipment, fixtures and branches with gate, ball or butterfly valves.

.2 Use globe, DRVs, ball or butterfly valves for throttling service.

.3 Install piping close to building structure to minimize furring and conserve headroom. Group piping and run parallel to walls and ceilings.

.4 Cut tube square, ream tube ends and clean tubing and tube ends before joint assembly.

.5 Prepare roll groove joints in shop or field using groove rolling machine.

.6 Assemble roll groove joints using dry lubricated gaskets.

.7 Anchors, guide and support roll grooved piping in accordance with coupling manufacturer’s instructions.

.8 Before assembling solder or brazed joints, remove working parts of valves, clean inside of solder fittings and outside of mating pipe with emery paper and coat with flux.

.9 Solder or braze joints with blow torch or oxy-acetylene flame.

.10 Joint construction, buried:

.1 All sizes: brazed.

.11 Joint construction, above ground:

.1 Up to NPS 2½: soldered in all locations

.2 NPS 3 and larger: brazed in all locations

.3 NPS 3 and larger: grooved joint in exposed areas only.

(a) for greater clarity, “exposed areas” include inside service rooms and above lay-in tile ceilings, but excludes vertical and horizontal service shafts, above any other ceiling construction, and inside walls and partitions.

3.2 Testing and Balancing

.1 Pressure test piping before insulation is applied. Cut-out and replace leaking soldered or brazed fittings and retest.

.2 Balance supply systems and recirculation systems using lock shield globe valves or DVR.

END OF SECTION

DRAINAGE AND VENT PIPING – CAST IRON AND COPPER
22 13 16

1 GENERAL

1.1 Scope

.1 Provide cast iron pipe and fittings and/or copper tube and fittings for drain, waste and vent services.

.1 For aboveground and buried services.

.2 For drainage piping serving mechanical service rooms.

1.2 Related Sections

.1 22 13 21: Drainage Piping - Pumped

1.3 Applicable codes and standards

.1 Standards:

.1 CSA B70 Cast Iron Soil Pipe, Fittings, and Means of Joining

.2 CSA-B125 Plumbing Fittings.

.3 CSA B158.1 Cast Brass Solder Joint Drainage, Waste, and Vent Fittings

.4 CSA B602 Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe.

.5 ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings

.6 ASTM A888 Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications

.7 ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

.8 ASTM B32 Specification for Solder Metal

.9 ASTM B306 Standard Specification for Copper Drainage Tube (DWV)

.10 ASTM C564- Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.11 ASTM C1540 Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

.12 ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

.13 Canadian Pipe Institute Standard Specification

.14 Cast Iron Soil Pipe Institute (CISPI) Technical Manual

.15 CISPI 301 Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications

.16 CISPI 310 Specification for Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications

2 PRODUCTS

2.1 Copper drain waste and vent pipe and fittings, within building

.1 Pipe:

.1 Copper DWV tube, to ASTM B306

.2 Certification markings made by testing agency accredited by Standards Council of Canada.

.2 Fittings

.1 Cast brass to CSA B158.1

.2 Wrought copper to ANSI B16.29

.3 Solder

.1 Tin-antimony 95/5, to ASTM B32 alloy Sb5.

2.2 Cast iron pipe and fittings for drain waste and vent services

.1 Pipe and fittings:

.1 Cast to CSA B70, ASTM A74 or ASTM A888

.2 with heavy bituminous coating for buried service.

.2 Joints below grade:

.1 Plain end made up using mechanical sleeve joints to CSA B602 and ASTM C1540 with neoprene or butyl rubber compression gaskets to ASTM C564, with stainless steel sleeve and not less than four stainless steel drive clamps with stainless steel worm gears.

.2 Hub and spigot made up neoprene gasket to ASTM C564 and lubricating compound.

.3 Joints above ground:

.1 Plain end made up using mechanical sleeve joints to CSA B602 and ASTM C1540 with neoprene or butyl rubber compression gaskets to ASTM C564, with stainless steel sleeve and not less than four stainless steel drive clamps with stainless steel worms.

.2 Hub and spigot made up neoprene gasket to ASTM C564 and lubricating compound.

.4 Tie-rods:

.1 fabricated by double bolted riser clamps and 10mm (3/8 in) carbon steel rods, with riser clamp placed on each side of joint.

3 EXECUTION

3.1 Installation General

.1 Install suspended piping to grade, parallel and close to walls and ceilings to conserve headroom and space.

.2 Install piping close to building structure to minimize furring. Group piping and run parallel to walls and ceilings.

3.2 Cast Iron Piping

.1 Install cast iron drainage piping in accordance with Cast Iron Soil Pipe and Fittings (CISPF) Technical Manual.

.2 Lay buried piping in bedding prepared in accordance with Canadian Pipe Institute Standard Specification, on 150 mm (6 in) bed of clean sand, shaped to accommodate hubs and fittings, to line and grade as shown. Backfill with clean sand to 300 mm above top of pipe or to underside of floor slab whichever is less.

.3 For suspended piping, provide hangers within 450 mm (18 in) of each joint, at each change of direction, and within 450 mm (18 in) of the terminal end of each pipe run.

.4 Assemble and tighten mechanical sleeve joints to coupling manufacturers recommended torque value with torque wrench.

.5 Provide braces or tie-rods on horizontal piping NPS 5 and larger:

.1 at each branch opening or change of direction,

.2 at each pipe run coupling.

.6 Provide sway bracing on all horizontal piping where the hanger length is greater than 450 mm (18 in) from the top of the pipe to the connecting point on the structure.

.7 Install cast iron hub-and-spigot joints with neoprene compression gasket and lubrication in accordance with manufacturer requirements.

3.3 Copper Tubing

.1 Cut copper tube square, ream tube ends and clean tubing and tube ends before joint assembly.

.2 Before assembling solder joints, clean inside of solder fittings and outside of mating pipe with emery paper and coat with flux.

.3 Solder joints in copper pipe with blow torch or oxy-acetylene flame.

3.4 Testing

.1 Test before piping is concealed.

.2 Cut-out and replace leaking soldered fittings, remake joints in cast iron piping, and retest.

END OF SECTION

PLUMBING FIXTURES & TRIM
22 42 13

1 GENERAL

1.1 Scope

.1 Provide plumbing fixtures and trim.

1.2 Applicable codes and standards

.1 CSA-B45 Series, Plumbing Fixtures.

.2 CSA-B125 Plumbing Fittings.

.3 UL 1951 Electrical Plumbing Accessories

.4 ASME A112.6.1 Supports for Off-the-Floor Plumbing Fixtures for Public Use

1.3 Fixture count

.1 Determine number and location of fixtures from Architectural drawings. In the absence of architectural drawings, refer to Mechanical drawings.

1.4 Fixture quality standards

.1 Fixtures and trim of same type to be product of one manufacturer.

.2 Finished surfaces to be clear, smooth and bright, and guaranteed not to craze, discolour or scale.

.3 Visible parts of faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops: chrome plated.

.4 Water supply faucet spouts fitted with aerators.

2 PRODUCTS

2.1 Sink Type "EW-1"

.1 Seamless die-down construction of 18-gauge, type 304, 18-8 stainless steel. Interior and top surfaces polished to a non-porous Hand-Blended Just Finish with highlighted bowl rim. Smooth, fully coated underside insulates for sound and reduces condensation. Certified to ASME A112.19.3/CSA B45.4, Canadian Standards Association (CSA), Uniform Plumbing Code (UPC), International Plumbing Code (IPC), Americans with Disabilities Act (ADA). Drain punched for J-35 drain.

.2 Faucet: Delta model 1500T4670 Hardwired Wallmount Gooseneck Spout with Integral Sensor in Base and Control Box, Spout: R5 - Smooth End Gooseneck - 6.0" spout reach - 12.0" height (unmounted) - Standard rigid installation - Vandal resistant .090" wall thickness (R5SE), Outlet#: 7 - Smooth Spout End with Laminar Flow Control in Spout Base - 1.5 USGPM (5.7L/min), Vandal Proof Control Housing,
Thermostatic Mixing Valve: Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, Lead free brass body construction, High temperature limit stop, 125 PSI max supply pressure

.3 Eyewash station

.1 Guardian Model G5022 Deck mounted, hand-held eyewash/drench hose with ½" IPS U.S. made chrome-plated brass squeeze valve with replaceable stainless steel seat and locking clip, stainless steel squeeze handle with plastic cover, nylon handle, nylon deck flange with locator guide, and 8ft PVC hose. 2 spray heads with integral "flip-top" dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly. Unit shall include ANSI compliant sign. Undercounter hose guide bracket to prevent hose from tangling or binding. Provide thermostatic mixing valve Model 9201ew to provide a safe fluid supply for a single emergency eye/face wash, with a flow rate of 10 gpm.

.4 NPS 1½ rough brass "P" trap with cleanout.

.5 Rough brass NPS ½ lockshield stop on each supply.

.6 Sediment trap

.1 Provide new 1-1/2"ø sediment interceptor. Sediment interceptor shall have epoxy coating, cast iron body, gasketed cover, removable stainless-steel sediment basket, 2" IPS threaded connections. 10" clearance required above cover to remove sediment bucket.

2.2 Sink Type "SK-1"

.1 Seamless die-drawn construction of 16 gauge type 304 stainless steel. Interior and top surfaces polished to a non-porous Hand Blended Just Finish. Fully coated underside insulates for sound and reduces condensation. Straight sided compartment with 1-3/4" radius corners provides greater capacity. Drain punched for Just J-35 drain. Certified to ASME/CSA B45.4; UPC; IPC.

.2 Faucet: Delta model 1500T4670 Hardwired Wallmount Gooseneck Spout with Integral Sensor in Base and Control Box, Spout: R5 - Smooth End Gooseneck - 6.0" spout reach - 12.0" height (unmounted) - Standard rigid installation - Vandal resistant .090" wall thickness (R5SE), Outlet#: 7 - Smooth Spout End with Laminar Flow Control in Spout Base - 1.5 USGPM (5.7L/min), Vandal Proof Control Housing

.3 Thermostatic Mixing Valve: Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, Lead free brass body construction, High temperature limit stop, 125 PSI max supply pressure

.4 NPS 1½ rough brass "P" trap with cleanout.

.5 Rough brass NPS ½ lockshield stop on each supply.

.6 Sediment trap

.1 Provide new 1-1/2"ø sediment interceptor. Sediment interceptor shall have epoxy coating, cast iron body, gasketed cover, removable stainless-steel sediment basket, 2" IPS threaded connections. 10" clearance required above cover to remove sediment bucket.

2.4 Barrier-Free Water Closet Type "WC-1"

.1 American Standard 3351101.020 Toilet - AFWALL® MILLENNIUM™ FloWise®, Toilet, Wall-hung with wall outlet, Toilet operates in the range of 4.2 to 6.0 LPF (1.1 - 1.6 GPF), White finish Vitreous china, EverClean® antimicrobial surface, Elongated bowl, Concealed trapway design, Direct-fed siphon jet flush action, 38 mm (1-1/2") top spud, 254 x 305 mm (10" x 12") water surface area, Fully-glazed 54 mm (2-1/8") trapway, Condensation channel,

.2 Centoco 1500STSCCFE-001 Seat - FAST-N-LOCK, For elongated bowl, Open front, Heavy duty, Polypropylene, Toilet seat, Less seat cover, Plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish, The bolt and nut material shall be stainless steel, Dimensions:32 mm (1-1/4") high, 473 mm (18-5/8") long, 368 mm (14-1/2") wide

.3 Delta 81T201HWA-42-MMO Hardwired Flush Valve – Polished chrome plated vandal resistant metal cover with top mounted sensor operated H2Optics® electronics, True mechanical manual override button, ADA compliant, automatic operation hardwire powered infrared sensor, Hardwire adaptor 24VAC to 6VDC converter, Vandal resistant copper tube conduit, 24 VAC input, 6 second arming delay, provide compatible 110 to 24 VAC Transformer

.4 Watts ISCA-101-L/R-M11 Carrier - Industry Standard single Horizontal adjustable Closet Carrier, Tiling frame, patented compression seal faceplate assembly, epoxy coated cast iron, epoxy coated cast iron, with incremental measurements embossed onto legs to easily adjust height of carrier to most commonly used fixture requirements, epoxy coated cast iron, Plated hardware, neoprene bowl gasket, adjustable ABS nipple, integral test cap, 51 mm (2") no hub vent connections, 102 mm (4") no hub waste, Adjustable for standard and wheelchair height, chrome cap nuts, required minimum space is 292 mm (11-1/2")

2.5 Lavatory Type “LAV-1”

.1 Basin: Bradley Verge Lavatory System – model LVRD1, length: 762mm, Evero Natural Quartz, single hole centreset, complete with pedestal to conceal water supplies, valves, and waste assemblies,

.2 Faucet: Delta Model 590T0 automatic no touch faucet, hardwired with battery backup, With Surface Mount Control Box and Single Inlet Supply, include batteries, above deck serviceable components, solid brass design, chrome finish, low battery indicator, auto shut-off after 45 seconds, vandal resistant concealed aerator, 0.5 gpm (1.9 L/min) flow control spray aerator, for pre-mixed water, provide Model 0607xxA 24V Transformer, Vandal Proof Control Housing.

.3 Thermostatic Mixing Valve: Lawler TMM-1070-87500 Mixing Valve - The point of use mechanical mixing valve with thermostatic limit stop, Lead free brass body construction, High temperature limit stop, 125 PSI max supply pressure,

.4 Vandal resistant water supplies

.5 S-Chrome P-Trap

.6 Provide carrier or support system to suit basin

2.7 Self-contained thermostatic water mixing valves;

.1 one small for 1/3 rated flow,

.2 one large for 2/3 rated flow,

.3 sized for not more than 100 kPa (15 psi) pressure drop at rated flow.

.2 Construction:

.1 bronze, brass, copper and stainless steel construction,

.2 mounted on strut frame with integral return piping, circulator, aquastat, check valves, bypass piping and balancing valves,

.3 outlet test connection, ball valve shut off on each mixing valve outlet, cold water inlet and hot water inlet,

.4 dial thermometers on hot, cold, mixed and return piping,

.5 adjustable high temperature limit stops set for 50°C (120°F),

.6 pressure gauge on tempered water piping,

.7 pre-assembled in accordance with schematic detail, and factory tested.

2.8 Sealant between fixture and wall finish:

.1 One part acetoxy silicone sealant

.2 White or clear colour

.3 Formulated with fungicide

3 EXECUTION

3.1 General

.1 Casework tender package shall supply only faucets, sinks, and eye wash stations. Contractor to take ownership, install, and warranty.

.2 Contractor to provide all other items listed in this specification under this contract.

3.2 Fixture installation

.1 Support fixtures level and square and connect with supplies, drains, traps and vents.

.2 Hot water faucets to be on left.

.3 Fixtures on outside walls to have water supplies from floor, other fixtures to be served from walls.

.4 Mounting heights for wall hung fixtures and showers to be measured from finished floor.

.5 Provide field installed in-line brass bodied swing check valves on the hot and cold water supplies to each TMV unit. For greater certainty, if the TMV unit is supplied with integral check valves they are deemed not to meet this requirement.

.6 Install sediment trap in compliance with AODA requirements.

3.3 Protection

.1 Plumbing fixtures and trim to be covered with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.

.2 Clean fixtures, and trim immediately prior to building completion.

3.4 Fixture supports

.1 Provide plates, brackets, wall carriers, cleats, and supports to secure fixtures in place.

.2 Fasten wall brackets with bolts attached to double steel supporting plates.

.3 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.

.4 Install extra heavy chair carriers for fixtures not directly supported from floor.

.5 Conceal vertical supports and baseplates in wall construction.

.6 Apply sealant bead between wall mounted fixture and finished wall.

.7 Floor mounted water closet bowls to be set in mastic.

3.5 Hot Water Temperature Limits

.1 Test, adjust and set high temperature limit stops on shower fixtures to supply a maximum water temperature of 49°C (120°F).

.2 Provide a report of this testing and include:

- .1 fixture reference,
- .2 measured maximum temperature,'
- .3 date of test(s),
- .4 signature of person(s) conducting test.

.3 The above tests are subject to a demonstration test audit of up to 10% of the total fixture count to verify compliance. If audit tests are not satisfactory to the Consultant, additional testing and verification will be conducted by the Contractor until such time as a demonstration audit provides satisfactory results to the Consultant.

END OF SECTION

WATER SPECIALTIES - HEATING AND COOLING
23 21 11

1 GENERAL

1.1 Scope

.1 Provide water specialties in accordance with this Section for systems where working temperatures are in range of -12°C to 120°C (10°F to 248°F) and working pressure up to 1035 kPa (150 psi).

.2 This section covers specialties for:

.1 Hot water and low temperature heating system

.2 Water system relief valve vents & overflows

1.2 Shop Drawings

.1 Submit manufacturer's data sheets for:

.1 air vents,

.2 separators,

.3 strainers,

.4 pressure reducing valves,

.5 pressure relief valves,

.6 water make-up assemblies.

2 PRODUCTS

2.1 Automatic air vents

.1 Float operated with brass or cast-iron body;

.1 design pressure: 1035 kPa (150 psi) working pressure.

Standard of Acceptance
- Maid-O-Mist No. 75
- Taco 418
- Amtrol No. 720
- Spirax Sarco - Fig. 13W
- Grinnell - Fig. 1401
- ITT Bell & Gossett - Model 107

2.2 Automatic radiator air vents

.1 Float operated with brass body;

.1 design pressure: 1035 kPa (150 psi)

Standard of Acceptance
- Maid-O-Mist No. 37
- Taco 417
- Braukman No. EA122
- Spirax Sarco - Fig. AE30

2.3 Hydronic system pressure safety relief valves

.1 Brass or iron body to ASME Section IV;

.1 adjustable pressure setting from 55 to 172 kPa (8 to 25 psi),

.2 operating differential pressure from open to close not more than 20 kPa (3 psi).

2.4 Strainers:

.1 "Y" pattern:

.1 NPS 3 and smaller, WOG service:

(a) bronze, cast iron or steel bodies,
(b) design pressure: 1030 kPa (Class 150)
(c) fittings: screwed or flanged to match specification for fittings in section of piping system where strainer is to be installed,
(d) basket: stainless steel, 0.8 mm ($^{1}/_{32}$ in) diameter perforations.

.2 NPS 4 and larger, WOG service:

(a) bronze, cast iron or steel bodies,
(b) design pressure: 1030 kPa (Class 150)
(c) fittings: flanged,
(d) basket: stainless steel, 3.2 mm (⅛ in) diameter perforations,
(e) baskets with 3.2 mm (⅛ in) diameter perforations: made from 0.9 mm (0.037 in) stock reinforced with 13 mm x 0.9 mm (½ in x 0.037 in) bands of same material spot welded to baskets.
(f) Blow-down NPS 3/4 threaded connection.

2.5 Water pressure reducing valves :

.1 Construction:

.1 self-contained hydraulic pilot controlled type,

.2 single seated with resilient disc in iron body.

.3 bronze seat for pressure drops below 480 kPa (70 psi), and

.4 stainless steel seat for 480 kPa (70 psi) and over,

.5 diaphragm suitable for 120°C (250°F) service.

Standard of Acceptance
- Singer Valve (Syntec)
- Cla-Val
- GA

3 EXECUTION

3.1 Air vents

.1 Provide isolating valves installed between unit and piping.

.2 Install air vents at high points, and in sections of piping subject to air binding, in both supply and return mains.

.3 Pipe vent outlets to discharge to drain, over janitors sinks, over floor drains in mechanical rooms and other similar visible locations.

3.2 Air vents for radiators

.1 Install radiator air vents on 20 mm (¾ in) by 50 mm (2 in) long air chambers on return side of hot water convector-radiators and wall fin heaters connected to top of flow risers. Pipe vent outlets to drain in visible locations.

.2 Fit other hot water convector-radiators with 20 mm (¾ in) by 150 mm (6 in) air chamber with screwdriver operated air vent piped through front or side of cabinet. Fit similar air chamber and screwdriver operated air vent, through front or side of cabinet, on high points of other wall-fin heating elements except that air chamber to be as long as is possible to install within wall-fin enclosure height.

.3 Install air vent assemblies clear of dampers within heating units.

3.3 Pressure safety relief valves

.1 Install on hot water boilers, heating convertors, expansion tanks and other pressure vessels in accordance with relevant codes

.2 Pipe outlets to drain.

3.4 Strainers

.1 Install strainers in horizontal or down flow lines with clearance for removal of basket.

.2 Up to NPS 2 size provide screwed blind caps.

.3 On water and glycol systems NPS 2½ and over provide NPS 1 valved blowout connection, consisting of ball valve with hose end and chained cap. Pipe valved blowout connections from strainers at pumps to open drain.

.4 Provide line size strainer in each of following locations

.1 On inlet side of water meters

.2 On inlet side of control valves (except at reheat coils with piping connections NPS ¾ or less, radiation, or radiant panels)

.3 On inlet side of pressure reducing valves

.4 On suction side of water circulating pumps

3.5 Pressure reducing valves

.1 Install pressure reducing valve stations with shut-off valve on either side of assembly and 115 mm (4½ in) pressure gauges on upstream and downstream sides of station.

END OF SECTION

STEEL PIPE AND FITTINGS - HEATING AND COOLING
23 21 13

1 GENERAL

1.1 Scope

.1 Provide steel pipe and fittings for systems where working temperatures are in range of -10°C to 120°C (14°F to 248°F) and working pressure is less than 860 kPa (125 psi).

.1 No zinc plated galvanized steel piping shall be used in IT room. Use hot dipped galvanized instead.

1.2 Shop drawings

.1 Submit shop drawings where pipe assemblies with fittings, elbows and flanges are shop fabricated.

1.3 Applicable codes and standards;

.1 Provide materials to:

.1 ASTM A47 Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.3 ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

.4 ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High-Pressure or High-Temperature Service, or Both.

.5 ASTM A536 Standard Specification for Ductile Iron Castings.

.6 ANSI A21.11 Rubber Gasket joints for Ductile-Iron Pressure Pipe and Fittings

.7 ANSI B1.20.1 Pipe Threads, General Purpose (inch)

.8 ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

.9 ANSI/ASME B16.3 Malleable Iron Threaded Fittings.

.10 ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings

.11 ANSI/ASME B16.9 Factory Made Wrought Steel Buttwelding Fittings

.12 ANSI/ASME B16.20 Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.

.13 ANSI/ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges.

.14 ANSI/ASME B18.2.1 Square and Hex Bolts and Screws,

.15 ANSI/ASME B18.2.2 Square and Hex Nuts

.16 CSA B242 Groove and Shoulder Type Mechanical Pipe Couplings

.17 CSA W47.1 Certification of Companies for Fusion Welding of Steel.

.2 Install piping to:

.1 AMSI/ASME B31.9 Building Service Piping

2 PRODUCTS

2.1 Steel pipe for heating and cooling water and glycol service

.1 Hydronic piping service, carbon steel:

.1 NPS 1/2 to 10:

(a) ASTM A106 Gr B, schedule 40 seamless, or

2.2 Pipe joints for sizes NPS 2 and under

.1 Threaded:

.1 threaded malleable iron fittings, Class 150 to ANSI B16.3

.2 1030 kPa (Class 150) black malleable iron, bronze face, ground joint unions.

Standard of Acceptance
- Anvil

2.3 Pipe joints for sizes NPS 2 ½ and over

.1 Welding fittings:

.1 wall thickness to match pipe

.2 butt weld type to ANSI B16.9

.2 Flanges:

.1 raised face style to CSA W47.1

.2 cast iron Class 150 to ANSI B16.1.

.3 forged steel, 1035 kPa (150 #) to ANSI B16.5, weld neck with wall thickness to match pipe, or slip on type.

.4 studs, bolts and nuts to ANSI B18.2.1, ANSI 18.2.2 and ASTM A194, “high strength” type.

.5 gaskets to ANSI B16.21, ANSI B16.20 or ANSI A21.11 of red rubber sheet 1.6 mm ($^{1}/_{16}$ in) thick

Standard of Acceptance
- Chesterton 100
- Beldam Red Rubber

.3 Rolled or cut grooved standard or rigid fittings and couplings:

.1 to CSA B242 with dry lubricated EPDM gaskets,

.2 malleable iron to ASTM A47 or ductile iron to ASTM A536 for grooved piping in sizes NPS 2½ to

.3 fabricated steel in sizes NPS 14 and over

.4 maximum working temperature is less than 100°C (210°F)

Standard of Acceptance
- Victaulic
- Gruvlock
- Couplox
- Shurjoint

3 EXECUTION

3.1 Piping installation

.1 Pipe joints:

.1 Piping NPS 2 and smaller: tapered pipe threads to ANSI B1.20.1and teflon tape or pipe thread sealant similar to Masters Pro-Dope

.2 Piping NPS 2½ and larger: welded with butt weld fittings or made up with grooved pipe and couplings.

.2 Equipment connections:

.1 NPS 2 and smaller: unions and threaded fittings

.2 NPS 2½ and larger: flanged connections.

.3 Install concealed pipes close to building structure to keep furring spaces to minimum and minimize obstruction to other services in ceiling spaces.

.4 Run exposed piping parallel to walls and conserve headroom and space. Group piping wherever practical.

.5 Slope main piping up in direction of flow 1:1000 (⅛ in in 10 ft).

.1 Branch piping to have greater slope.

.6 Use eccentric reducers at pipe size changes arranged flat on bottom to assist venting.

.7 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.8 Ream pipe after cutting to length and clean off scale and dirt inside and outside of pipe before threading grooving or welding.

.9 Cap ends during construction to prevent entry of foreign matter.

.10 Branches may be welded directly into main provided main is more than NPS 4 and branch is at least 2 pipe sizes smaller than main. Cut openings in main true and beveled. Branch pipes are not to project inside main pipe. Openings to be sized to prevent entry of welding metal and slag into pipes.

.11 Where saddle type branch welding fittings are used on mains, hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding.

.12 No zinc plated galvanized steel piping shall be used in IT room. Use hot dipped galvanized instead.

3.2 Groove joint piping

.1 Make pipe ends clean and free of indentations, projections and roll marks, between the end of the pipe and the groove.

.2 Verify gasket style and material grade with supplier for use with intended service.

.3 Provide for manufacturers' service representative to conduct on-site training prior to piping rough-in and installation.

3.3 Flushing and cleaning

.1 After hydraulic pressure test, flush to drain with clean water for minimum of four hours.

.2 Isolate system from other piping systems. Drain and fill with solution of water and non-foaming, phosphate free detergent, 3% by weight. Provide temporary pump for additions to existing systems and circulate solution for minimum of eight hours.

.3 Flush to drain with clean water for four hours. Remove and clean strainers.

.4 Drain and refill system with clean water and circulate for two hours. Inspect strainers, and repeat drain, fill and recirculate routine until strainers are free of debris.

END OF SECTION

COPPER PIPE AND FITTINGS - HEATING AND COOLING
23 21 14

1 GENERAL

1.1 Scope

.1 Provide copper pipe and fittings for systems where working temperatures are in range of -10°C to 120°C (14°F to 248°F), working pressures are less than 1035 kPa (150 psi), and maximum pipe size is NPS 4.

1.2 Applicable codes and standards

.1 ASTM B88 Standard Specification for Seamless Copper Water Tube

.2 ASME B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250

.3 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

.4 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.5 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings; Class 150, 300, 400, 600, 900, 1500, & 2500.

.6 ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

.7 AWWA C111/ ANSI A21.11 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

.8 ASTM A307 Standard Specification for Carbon Steel Bolts and Studs 60,000PSI Tensile Strength

.9 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

.10 ASTM B32 Specification for Solder Metal

2 PRODUCTS

2.1 Copper pipe

.1 Type K hard drawn copper tubing to ASTM B88.

2.2 Fittings

.1 Cast bronze to ANSI B16.18.

.2 Wrought copper and bronze to ANSI B16.22.

2.3 Flanges

.1 Brass or bronze to ANSI B16.15.

2.4 Solder

.1 95:5 tin: antimony solder to ANSI B16.18 and ASTM B32

3 EXECUTION

3.1 Application

.1 Copper piping to be used for;
- .1 Hot water and low temperature heating system,
- .2 Exterior zone heating and cooling system,
- .3 Glycol heating and cooling systems,
- .4 Condenser water system,
- .5 Chilled water system.

3.2 Piping installation

.1 Connect to equipment with flanged connections where pipe size is NPS 2½ and larger and with unions and screwed fittings where connections are NPS 2 and smaller.

.2 Install concealed pipes close to building structure to keep furring spaces to minimum and minimize obstruction to other services in ceiling spaces.

.3 Run exposed piping parallel to walls and conserve headroom and space. Group piping wherever practical.

.4 Slope main piping up in direction of flow 1:1000 (⅛ in in 10 ft). Branch piping to have greater slope.

.5 Use eccentric reducers at pipe size changes arranged flat on bottom to assist venting.

.6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.7 Ream pipes and clean scale and dirt from both inside and outside before assembly.

.8 Isolate steel pipe and equipment from copper pipe with di-electric fittings or bronze adapters manufactured for this purpose.
- .1 Bronze body valves may be used for di-electric isolation.

3.3 Flushing and cleaning

.1 After pressure test, flush to drain with clean water for minimum of four hours.

.2 Isolate system from other piping systems. Drain and fill with solution of water and non-foaming, phosphate free detergent, 3% by weight. Provide temporary pump for additions to existing systems and circulate solution for minimum of eight hours.

.3 Flush to drain with clean water for four hours. Remove and clean strainers.

.4 Drain and refill system with clean water and circulate for two hours. Inspect strainers, and repeat drain, fill and recirculate routine until strainers are free of debris.

.5 Drain and refill system with clean water adding water treatment chemicals.

END OF SECTION

AIR DISTRIBUTION - GENERAL
23 31 01

1 GENERAL

1.1 Scope

.1 Provide labour, materials and equipment for installation, testing and putting into operation ventilating and air conditioning systems

1.2 Qualified tradesmen

.1 Work to be done by qualified tradesmen holding certificates of competency.

1.3 Applicable standards

.1 The Ontario Building Code

.2 Regulations of Province, City, or local authority having jurisdiction.

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 Ductwork

.1 Ductwork system routing is shown diagrammatically. Drawings are not considered to be fabrication or installation drawings.

.2 Locate mains, risers and runouts to be concealed behind furrings or above ceilings except in mechanical equipment rooms and access spaces where ductwork is to be exposed.

.3 Determine areas without ceilings from Architectural Drawings and Room Finish Schedules, and in these areas keep ductwork as high as possible.

.4 Anchor, guide and support vertical and horizontal runs of ductwork to resist dead load and absorb thrust.

3.2 Air supply equipment

.1 Install and connect air handling units, and air conditioning units, and build casing and plenums.

3.3 Air exhaust equipment

.1 Install and connect exhaust fans, roof and wall exhausters and dust and fume collectors.

3.4 Terminals devices

.1 Locate and install terminal boxes, registers, diffusers, and grilles

3.5 Life safety

.1 Install fire dampers, smoke dampers, and combination smoke and fire dampers to protect openings in fire separations.

.2 Provide smoke stopping around unprotected ducts passing through smoke separations.

3.6 Air balancing

.1 Co-operate with air balancing agency; install supplementary dampers, access openings and access doors to facilitate testing and adjustment.

END OF SECTION

DUCTWORK
23 31 13

1 GENERAL

1.1 Scope

.1 Provide metal ductwork systems as shown.

1.2 Applicable Codes and Standards

.1 Installation standards and codes

.1 NFPA 90A Installation of air conditioning and ventilating systems.

.2 NFPA 90B Installation of warm air heating and air conditioning systems.

.3 ASHRAE Letter and number designations, shown as “CR3-16" etc., are taken from ASHRAE Duct Fitting Data Base.(DFDB)

.4 ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible (2005 edition)

.2 Product standards:

.1 ASTM A90/M Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

.2 ASTM A653/M Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

.3 ASTM A924/M Standard Specification for General Requirements for Steel Sheet, Metallic- Coated by the Hot-Dip Process

.4 ASTM A1011/M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability,
and Ultra-High Strength

.5 ASTM A283/M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

.6 ASTM A36/M Standard Specification for Carbon Structural Steel

.7 ASTM A480/M Specification for General requirements for Flat Rolled Plate, Sheet, and Strip

.8 ASTM A463/M Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

.9 ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.3 Shop Drawings and Application Details

.1 Submit manufacturer's catalogue literature for;

.1 Proprietary joints,

.2 Hardware.

.2 Submit field/fabrication drawings at 1:50 (¼ inch=1 foot) or larger scale, with piping, ductwork, and fittings in double line format, to show;

.1 arrangements in congested areas,

.2 where installation proposed deviates substantially from layout shown, and

.3 where installation requires joints for field assembly in welded duct construction.

.3 For greater clarity, do not submit field/fabrication drawings for other areas of the Work.

.4 Submit schedules and details to show;

.1 fabrication details of

(a) connections to risers in duct shafts
(b) balancing damper construction,
(c) fittings where geometry contemplated is different from that specified.

.2 in chart form

(a) duct system pressure class,
(b) duct sheet gauges,
(c) joint types and application criteria,
(d) location criteria and dimensions for bracing, stiffeners and balancing dampers
(e) duct leakage class, and
(f) extent of sealing.

1.4 Record Drawings

.1 As work progresses, mark-up field drawings and submit as part of record of “As-Built” conditions.

1.5 Qualifications

.1 Ductwork systems to be provided by firm having an established reputation in this field.

2 PRODUCTS

2.1 Basic material

.1 Galvanized steel:

.1 Ducts and connectors: lock forming quality to ASTM A653 or ASTM

A924, (a) Z275 (G90) zinc coating for indoor and outdoor ductwork.

.2 Miscellaneous pipe, angles, strips and threaded rod in contact with ductwork: galvanized with a minimum thickness equal to ASTM A653 - Z275 (G90).

.2 Stainless steel:

.1 To ASTM A480, Type 316L

.3 Aluminum:

.1 To ASTM B209;

(a) alloy 3003-H14 or 5052-H32 for sheet material.
(b) alloy 6061-T6 for plate material
(c) alloy 6061-T4 or T6 for shapes material.

.4 Plain mild carbon steel:

.1 To ASTM A1011, A283, A572 and A36 as applicable.

2.2 Joints

.1 Flanged duct joints:

.1 proprietary roll-formed flanges, corner pieces, integral edge seals, gaskets and cleats.

.2 material to match that of ductwork being joined.

Standard of Acceptance
- Ductmate – System 25/35/45
- Carlisle Canada - Nexus

2.3 Sealant and tape

.1 To section 23 33 05 Duct Accessories.

2.4 Hangers and supports

.1 Upper hanger attachments;

.1 in new concrete: manufactured concrete inserts.

Standard of Acceptance
- Myatt Fig. 485

.2 for steel joist: galvanized joist clamps or steel plate washer.

Standard of Acceptance
- Anvil Fig. 61 or 86
- Anvil Fig. 60 for plate washer

.3 for steel beams: galvanized beam clamps.

Standard of Acceptance
- Anvil Fig. 60

.2 Seismic supports and restraints to Section 20 05 49 Seismic Restraint

2.5 Duct access doors

.1 To section 23 33 05 Duct Accessories.

3 EXECUTION

3.1 Construction

.1 Construction details, sheet gauges, reinforcing, and bracing to be taken from SMACNA HVAC Duct Construction Standards - Metal and Flexible except as otherwise shown.

.2 Rectangular ductwork:

.1 longitudinal seams: Pittsburgh Lock, with specified sealant applied prior to hammering of joint,

.2 transverse joints: to SMACNA HVAC standards based on pressure class and reinforcement used and sealing requirements.

.3 Round ductwork, 500 Pa (2 in wg) pressure class and higher:

.1 spiral flat type longitudinal seam, button punched.

3.2 Pressure classification and seal class

.1 Low pressure ductwork construction classification:

Table 1: Duct Pressure Classification

Pressure class Pa (in wg)	Operating pressure Pa (in wg)	Velocity m/s (fpm)	Leakage Test Pressure Pa (in wg)
125 (½)	up to 125 (½)	10.0 (2000)	125 (½)
250 (1)	125 to 250 (½ to 1)	12.5 (2500)	250 (1)
500 (2)	250 to 500 (1 to 2)	12.5 (2500)	500 (2)
750 (3)	500 to 750 (2 to 3)	15.0 (3000)	750 (3)
Greater than 750 (3)	High Pressure Ductwork		Not less than 1000 (4)

.2 Assemble ductwork seams and joints with joint sealant as shown in table 2.

.3 Sealant application:

.1 store duct sealant at room temperature for 24 hours before use,

.2 apply sealant on seams as noted in table 1, and brush or extrude sealant to cover fasteners,

.3 on bell and spigot style joints apply sealant on male section with caulking gun and spread sealant evenly on mating surface with brush,

(a) insert fitting and secure with sheet metal screws
(b) brush sealant onto outside of assembled joint in 50 mm (2 in) wide band covering fastener heads,

.4 allow 40 hours curing time before pressure testing.

Table 2: Duct System Pressure and Seal Class

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
1	Supply risers in vertical service space (duct shafts).	+1000 (4)	B	Transverse joints, longitudinal seams, and other connections
2	Return/exhaust air ductwork between HEPA filters and suction side of fan.	-1000 (4)		
3	Return/exhaust air ductwork between a Heat Recovery Wheel and suction side of fan.	-1000 (4)		
4	Supply air ductwork from discharge side of fan to inlet of terminal box or reheat coil; Return air ductwork on discharge side of fan.	+750 (3)		
5	Return/Exhaust risers in mechanical rooms and vertical service spaces (duct shafts).	-750 (3)		

Table 2: Duct System Pressure and Seal Class

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
6	Supply air ductwork upstream of HEPA filters, including diffusers with integral HEPA filters.(5)	+750 (3)		
7	Return and/or exhaust air ductwork on suction side of fans other than in mechanical rooms and vertical service spaces.	-500 (2)	C	Transverse joints and other connections
8	Supply air ductwork on downstream side of terminal units or reheat coil; Exhaust air ductwork on discharge side of fan; Fan coil units, suction and discharge.	250 (1)	C	Transverse joints only

Notes for table 2:
(1) Transverse joints are connections of two duct or fitting elements oriented perpendicular to flow,
(2) Longitudinal seams are joints oriented in direction of flow,
(3) Duct wall penetrations are openings made by screws, non-self-sealing fasteners, pipe, tubing, rod and wire,
(4) Other connections such as spin-ins taps and other branch fittings inserted into cut openings in duct, access door frames, insertion type control elements and duct joints at equipment are to be treated as transverse joints.
(5) This pressure class also applies to supply ductwork downstream of a terminal box or reheat coil which serve diffusers with integral HEPA filters.

3.3 Fittings - Rectangular Ductwork

.1 Refer to Annex A at the end of this Section for illustrations of referenced fitting types.

.2 Elbows:

.1 Elbows are to be installed as shown, or if not shown, in descending order as listed in table 3.

(a) for clarity, elbows types are to be selected based on the highest order number (where 1 is the highest) which will fit the available space.

Table 3: Rectangular Duct, Elbows

Order No.	ASHRAE Fitting No.	Description	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Minimum Throat Radius mm (in)	Remarks
1	CR3-1	Smooth radius Unvaned elbow	1.5	≤ 300 (12)	---	Default
			1.0	> 300 (12)	---	
2	CR3-3	Smooth radius Vaned elbow	0.75	≤ 900 (36)	150 (6)	One full radius single thickness splitter vane

Table 3: Rectangular Duct, Elbows

Order No.	ASHRAE Fitting No.	Description	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Minimum Throat Radius mm (in)	Remarks
	CR3-4	Smooth radius Vaned elbow	0.75	> 900 (36) ≤ 1500 (60)	150 (6)	Two full radius single thickness splitter vane
	CR3-5	Smooth radius Vaned elbow	0.75	> 1500 (60)	150 (6)	Three full radius single thickness splitter vane
3	CR3-15	Square Mitred Vaned elbow	Square throat; Square heel.	--	---	Double thickness turning vanes; 50 (2) heel radius vane; 54 mm (2.125 in) vane spacing.
4	CR3-2	Radius Heel Sharp Throat	0.5	---	---	Double thickness turning vanes as per CR3-3, 4 or 5 depending on duct width

.2 First elbow on discharge side of fan:

(a) fitting CR3-1, unvaned elbow with throat radius 1.0 times duct width, with the required upstream effective length L_e of straight length of duct in accordance with fitting type SR7-5 or SR7-9 as applicable.

.3 Wye and tee branch fittings - Supply air systems:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 4.

Table 4 : Rectangular Duct, Wye and Tee Branch Fittings - Supply Air Systems

Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
1	For 750 Pa (3 in.w.g) pressure class and above: branch take-off from ducts in shafts, and ducts upstream of terminal boxes, filters and reheat coils	Smooth radius wye; diverging	SR5-1
		Dovetail wye	SR5-14
		Divided flow fittings	(SMACNA) 4A or 4B

Table 4 : Rectangular Duct, Wye and Tee Branch Fittings - Supply Air Systems			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
		45° entry branch diverging	SR5-13
2	Supply ducts downstream of terminal boxes, fan coil units, reheat coils or heat pumps	Tee, rectangular main to round conical tap	SR5-12
		Tee, 45° entry branch diverging	SR5-13
		Smooth radius wye; diverging	SR5-1

.4 Wye and tee branches - Return/Exhaust air systems:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 5.

Table 5 : Rectangular Duct, Wye and Tee Branch Fittings - Return/Exhaust Air Systems

Ref. No.	Return/Exhaust Ductwork System	Fitting Type	ASHRAE Fitting No
1	All pressure classes including branch connections at duct shafts	Smooth radius wye; converging	ER5-1
		Dovetail wye	ER5-4
		Divided flow fittings	(SMACNA) 4A or 4B
		45° entry branch diverging, where shown on drawings	ER5-3

.5 Transitions (Rectangular and Round):

.1 converging: maximum 20° angle between ductside and direction of flow,

.2 diverging: maximum 15° angle between ductside and direction of flow.

.6 Fabricate duct offsets using elbows selected in accordance with table 2 and as follows:

.1 single offset in single plane, less than duct height: made up with two 45° elbows,

.2 single offset, of greater displacement, made up with 90° elbows,

.3 double offset in single plane, less than duct height, made up with four 45° elbows,

.4 double offset in single plane, of greater displacement than duct height, made up with 90° elbows.

.7 Obstructions passing through duct:

.1 covered by round nosed streamline enclosure where free area of duct is reduced by less than 15%,

.2 fitted in round nosed streamline enclosure with duct width increase, SMACNA HVAC FIG 2-10, Detail E , with converging and diverging transition angle requirements as specified above.

3.4 Fittings - Round Ductwork

.1 Refer to Annex A at the end of this Section for illustrations of referenced fitting types.

.2 Elbows:

.1 Elbows are to be installed as shown, or if not shown, in order of available space as listed in table 6.

Table 6 : Round Duct, Elbows

Ref. No.	Description	ASHRAE Fitting No.	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Remarks
1	30° elbow	CD3-3*	1.5	≤ 300 (12)	Die stamped
		CD3-14*	1.5	> 300 (12)	2-Gore
2	45° elbow	CD3-3	1.5	≤ 300 (12)	Die stamped
		CD3-14	1.5	> 300 (12)	3-Gore
3	60° elbow	CD3-3*	1.5	≤ 300 (12)	Die stamped
		CD3-14*	1.5	> 300 (12)	4-Gore
4	90° elbow	CD3-1	1.5	≤ 200 (8)	Die stamped
		CD3-9	1.5	>200 (8) and ≤ 350 (14)	5-Gore
		CD3-10	1.5	>350 (14) and ≤ 900 (36)	7-Gore
			2.5	> 900 (36)	7-Gore

.3 Wye branches:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 7.

Table 7 : Round Duct, Wye and Tee Branch Fittings

Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
1	Downstream of supply fan.	Wye branch plus 45° elbow	SD5-2
		Tee, tapering	SD5-12
2	Downstream of terminal boxes.	Wye branch plus 45° elbow	SD5-1
		Tee, tapering	SD5-10
3	Return or exhaust duct branches.	Wye branch plus 45° elbow	ED5-2
4	Return or exhaust duct branches; equal main and branch duct size.	Tee, tapering, with 45° elbow	SD5-2

Table 7 : Round Duct, Wye and Tee Branch Fittings			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
5	Return or exhaust duct branches; smaller branch size.	Tee, tapering, with 45° elbow	SD5-12

3.5 Balancing dampers

.1 Provide splitter dampers where branch connections are taken from supply mains.

.2 Provide single blade dampers on each branch of supply air systems downstream of terminal boxes.

.3 Provide Opposed Blade Dampers (OBD) at branch and main connection on exhaust and return air systems.

3.6 Finishing, fastening and supports

.1 Hammer edges and slips to leave smooth finished surface inside duct.

.2 Support vertical ducts with angles riveted to duct and bearing on building structure.

.3 Hangers;

.1 Duct side up to maximum 500 mm (20 in) supported with strap hangers of same material as duct but one sheet metal thickness heavier.

.2 Extend strap hangers down duct side and turn under 50 mm (2 in) fastening securely to side and underside of duct.

.3 Duct side greater than 500 mm (20 in) supported with trapeze hangers constructed from galvanized steel angle with steel rods in accordance with table 8;

Table 8 : Duct Hangers		
Duct size mm (in)	Angle size mm (in)	Rod size mm (in)
up to 750 (up to 30)	25x25x3 (1x1x⅛)	6 (¼)
750 to 1050 (30 to 40)	40x40x3 (1½x1½x⅛)	6 (¼)
1050 to 1500 (40 to 60)	40x40x3 (1½x1½x⅛)	10 (⅜)
1500 to 2400 (60 to 90)	50x50x3 (2x2x⅛)	10 (⅜)
2400 and over (90 and over)	50x50x6 (2x2x¼)	10 (⅜)

.4 Maximum hanger spacing: 2.4 m (8 ft) on centre.

3.7 Sheet metal plenums:

.1 50 mm (2 in) thick thermally insulated double wall construction,

.2 inner (cold side) wall of galvanized steel,

.3 outer (room side) wall of galvanized steel,

.4 50 mm (2 in) thick, 72 kg/m^3 (4 lb/ft^3) density, glass fibre insulation, foil backed with vapour barrier on inner wall side,

.5 watertight, welded stainless steel type 304 floor panels, with upturned 50 mm (2 in) perimeter lip,

.6 thermal break; between adjacent wall panels, between wall panels and plenum roof panels, and between wall/roof panels and building structure.

3.8 Watertight ducts for dishwashers, humidifiers and showers

.1 Construction:

.1 locate longitudinal seams at top of horizontal ducts,

.2 with soldered or welded transverse joints between bottom sheets and side sheets, and

.3 with other longitudinal and transverse joints sealed with tape and duct sealer.

.2 Duct section at duct-mounted humidifiers:

.1 type 304 stainless steel, extended minimum of 1.0 m (3 ft) upstream and 3.0 m (10 ft) downstream from humidifier,

.2 welded transverse and longitudinal seams,

.3 built as a pan pan, with 50 mm (2 in) deep sides,

.4 sloped down in direction of airflow, with

.5 NPS ¾ drain connection from lowest point in bottom of duct, trapped and piped to drain.

.3 Shower exhaust ducts:

.1 aluminum construction, extended minimum of 1500 mm (5 ft) from shower exhaust grilles and sloped down to drain back through exhaust grilles served.

3.9 Protection of duct openings

.1 Cap off ends of unfinished ducts while plastering, drywall and other finishing operations are in progress,

.2 Cover open ends or registers of active exhaust/return ducts with 25 mm (1 in) thick filter media secured with tape. Maintain media until dust producing finishing operations are completed.

3.10 Duct access doors

.1 Provide for inspection and servicing of duct mounted components and cleaning of duct system;

.1 located such that any section of duct is not more than 15 m (50 ft) from point of access,

.2 at not more than 6 m (20 ft) intervals on supply air ductwork installed after HEPA filter,

.3 at base of each accessible duct riser,

.4 in front of and behind duct mounted coils,

.5 at activation side of fire, smoke, and combination fire/smoke dampers,

.6 and motorized dampers where damper actuator is located inside of duct or plenum.

.2 Door size:

.1 Select access door sizes based on smallest duct dimension in accordance with table 9.

Table 9 : Access Door Sizes

Smallest Duct Dimension mm (in)	Bottom of duct height above floor m (ft)	Location	Door Size mm (in)
≤ 350 (14)	Any	Side or bottom	300 x 150 (12x6)
>350 and ≤500 (>14 and ≤20)	Any	Side or bottom	450 x 250 (18x10)
>500 (>20)	≤3.6 (12)	Side or bottom	530x350 (21x14)
	>3.6 (12)	Bottom	635x430 (25x17)

3.11 Leak testing

.1 Test air duct systems for leaks at 1.00 times pressure specified for class as follows;

.1 between supply air handling units and terminal units

.2 between supply air handling units and air supply outlets on supply systems without terminal units

.3 between inlet grilles and exhaust/return fan inlet, and fan outlet and exhaust or mixing plenum, on return/exhaust systems,

.4 following parts of system are exempt from pressure testing;

(a) short duct runs of 15 metres (45 feet) or less, operating at 37 Pa (1/8 in) SP or less. (b) ductwork installed downstream of terminal boxes and fan coil units.

.2 Conduct test in accordance with Associated Air Balance Council (AABC) recommended procedures.

.3 Where audible air noise is detected during test, remove test, pressure apply sealant to leaking joints and seams, and retest after 48 hours. Continue testing and sealing until leaks are inaudible.

.4 Allowable ductwork leakage to be lesser of,

.1 1% of system airflow, or

.2 value calculated from following formula;

$$F = K \times C_L \times P^{0.65}$$

$$L = (A \times F) / 100, \text{ or}$$

$$L = (A \times K \times C_L \times P^{0.65}) / 100$$

Table 10: Flow Measurement Units

	Term	Flow Measurement		
		m^3/s	l/s	CFM
F	leakage coefficient	m^3/s per $100m^2$	l/s per m^2	CFM per 100 ft^2
C_L	leakage coefficient	Refer to table 11 below		
P	test pressure	kPa	kPa	in.wc.
L	Allowable leakage	m^3/s	L/s	CFM
A	Duct surface area	m^2	m^2	ft^2
K	unit conversion	1.24×10^{-2}	1	1

Table 11: Leakage Coefficient, C_L

Duct Type	Seal Class		
	C	B	A
Rectangular metal	24	12	6
Round Metal	12	6	3
Unsealed rectangular metal duct	48	48	48
Unsealed round or oval metal duct	30	30	30

.5 Calculate duct surface area for each test section and determine allowable leakage in accordance with formulae above. Test duct at pressure for specified class for 15 minutes. If leakage rate exceeds allowable value, caulk and seal joints, and repeat testing caulking and sealing process until measured leakage rate is less than calculated allowable value for section under test.

.6 Maintain set of drawings on site, coloured each day during testing to indicate extent of duct satisfying leakage criteria under test.

.7 Submit a written report, verified by TAB Agent, identifying each segment of duct system tested, showing calculation of allowable leakage, test pressure and leakage value measured under test, and certifying that leakage testing has been satisfactorily completed.

3.12 Duct cleaning

.1 Cleaning to be performed by agent specializing in this field of work, be a member in good standing with National Air Duct Cleaners Association (NADCA), and to comply with NADCA standards.

.2 Clean new horizontal and vertical ducts (supply, return, exhaust, transfer), as well as, existing supply and return ductwork connected to new fan systems.

.3 Clean ductwork using high powered vacuum system, hand tools and mechanical brushing systems such that metal surfaces are visibly clean.

.4 Reset balancing dampers to original settings if moved during work. Have TAB Agent confirm damper settings.

.5 Maintain set of drawings on site, coloured each day during cleaning to indicate extent of duct cleaning completed.

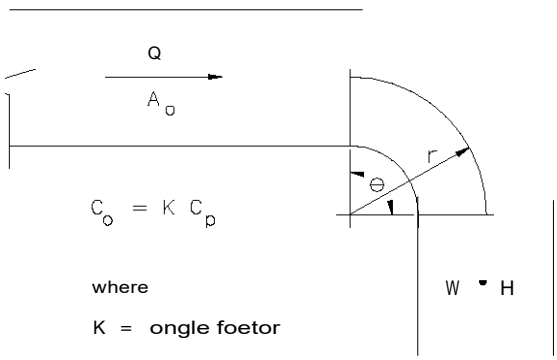
.6 Submit a written report, verified by TAB Agent, identifying extent of duct system cleaning and certifying that NADCA standards have been met.

3.13 Fitting Illustrations

.1 Illustrations of fitting referenced in this specification follows in Annex A.

Annex A – Illustration of Referenced Fittings

Rectangular Elbows (see Table 3)



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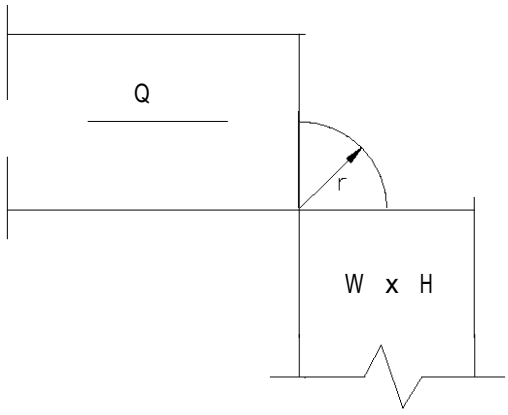

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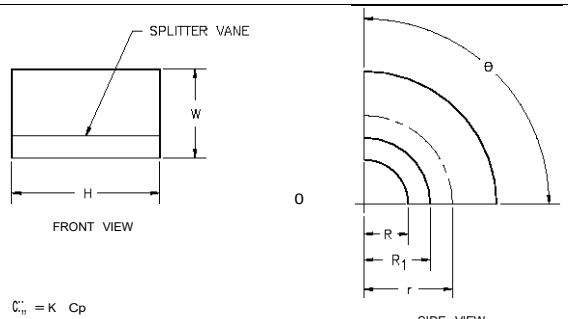

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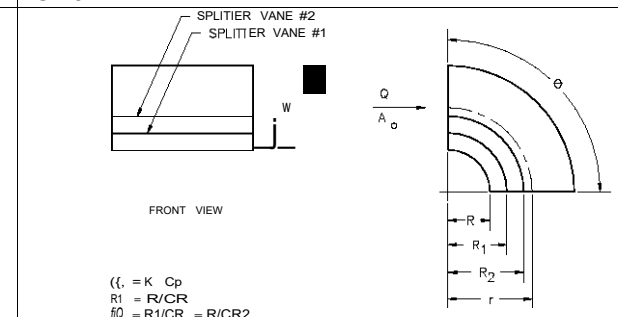

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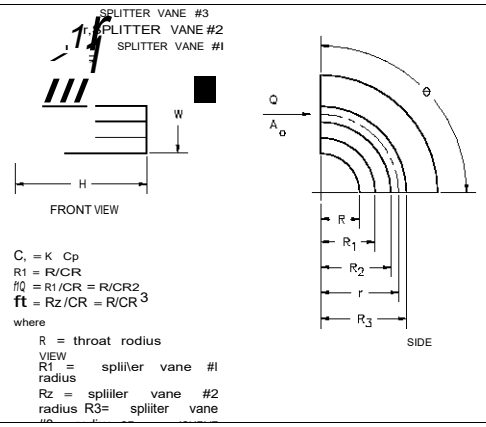
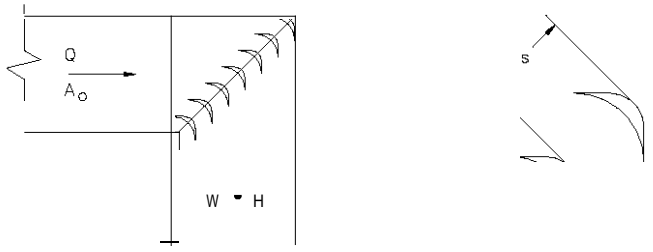
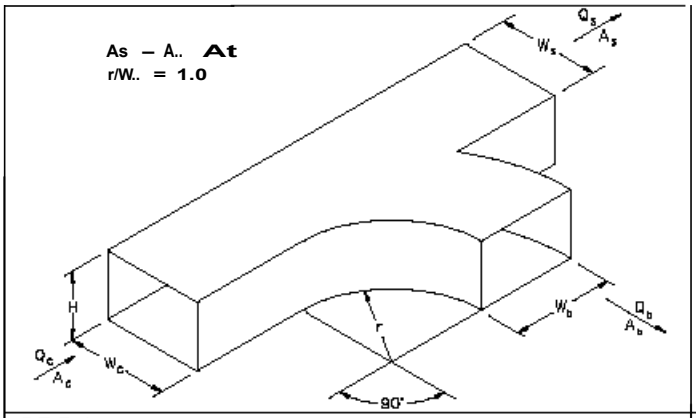


CR3-5

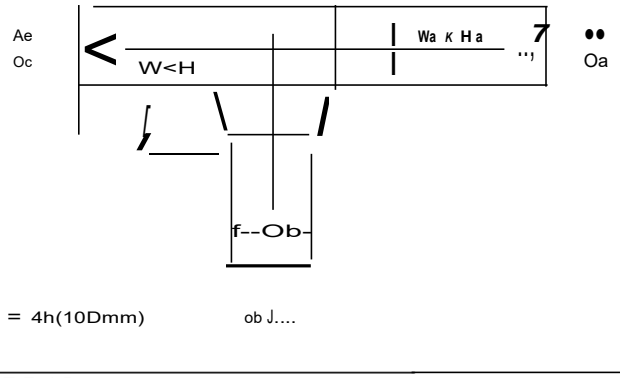


CR3-15

Rectangular Wyes and Tee's – Supply Ductwork (see Table 4)



SR5-1



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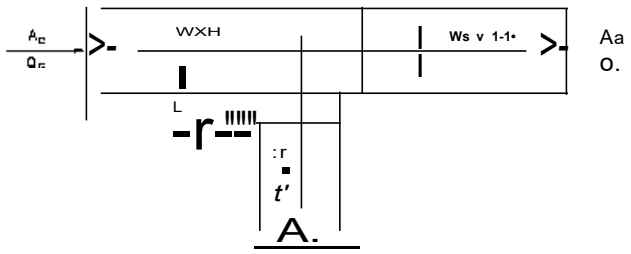
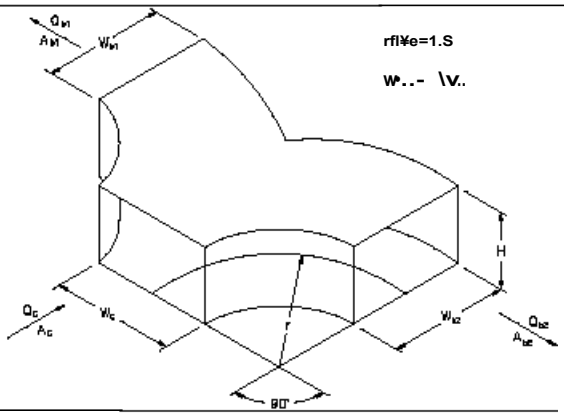


I – 0.25'Ab· 3 rn. (75mm) min.

SR5-13



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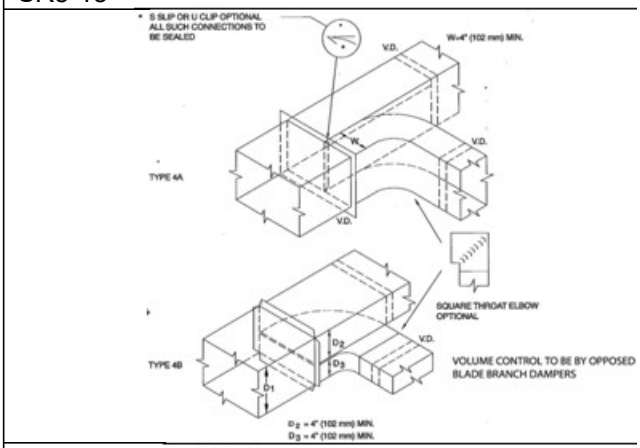
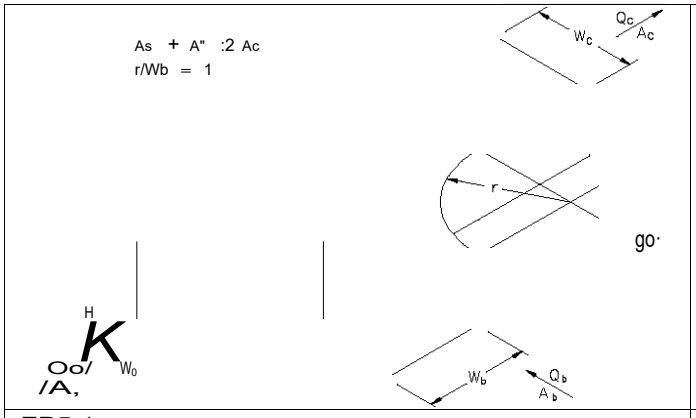
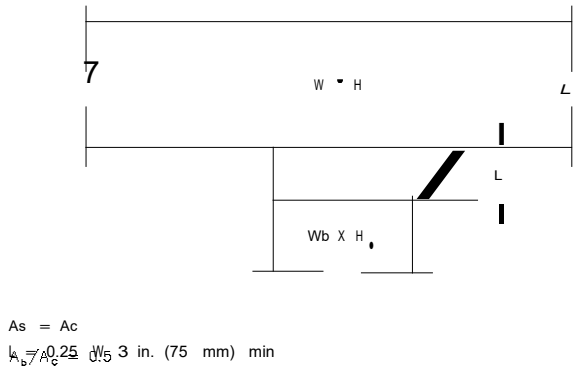


SMACNAFig. 4A/4B

Rectangular Wyes and Tee's- Return/Exhaust Ductwork (see Table 5)



ER5-1



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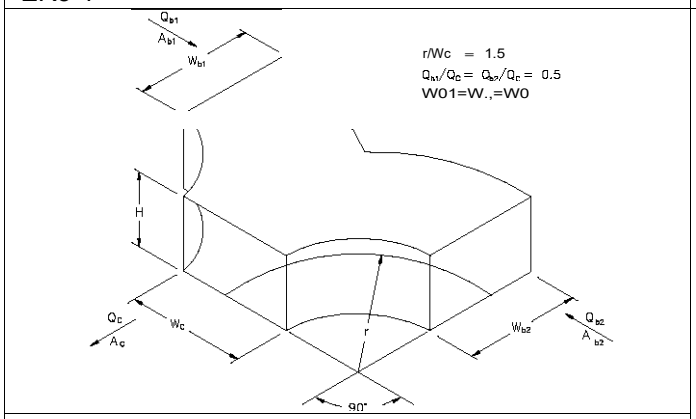
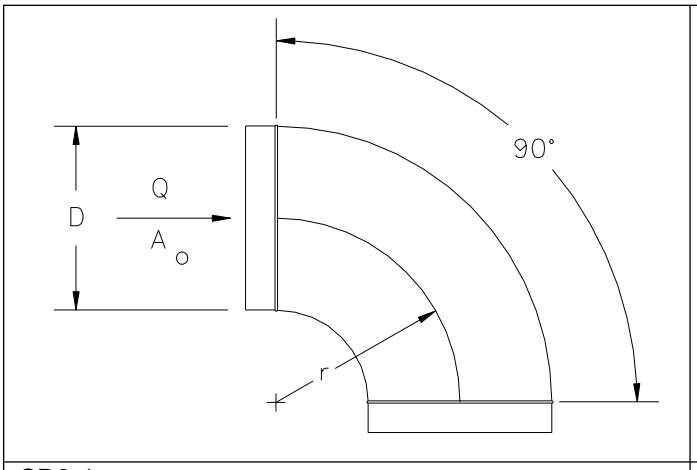
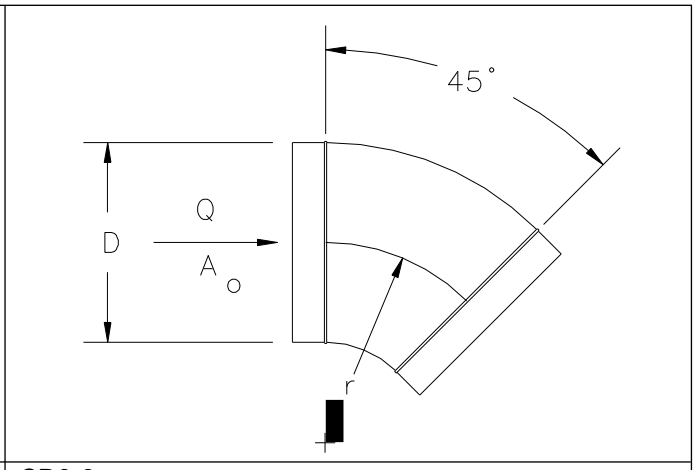


ER5-4

Round Elbows (see Table 6)



CD3-1



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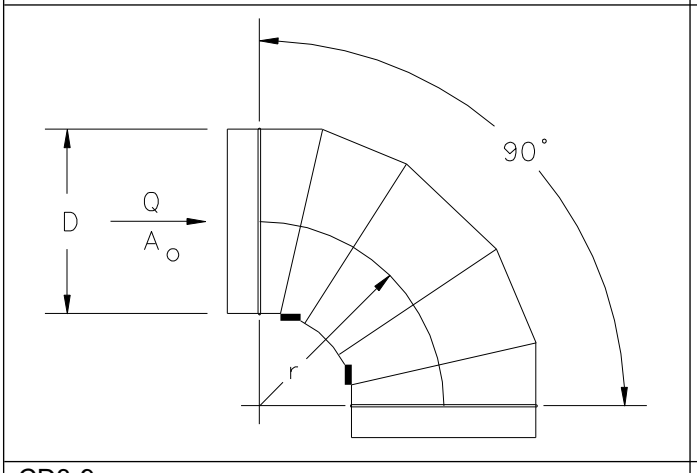

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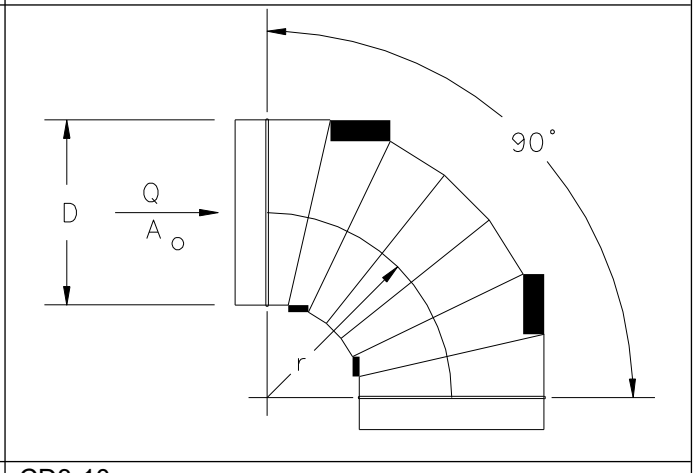

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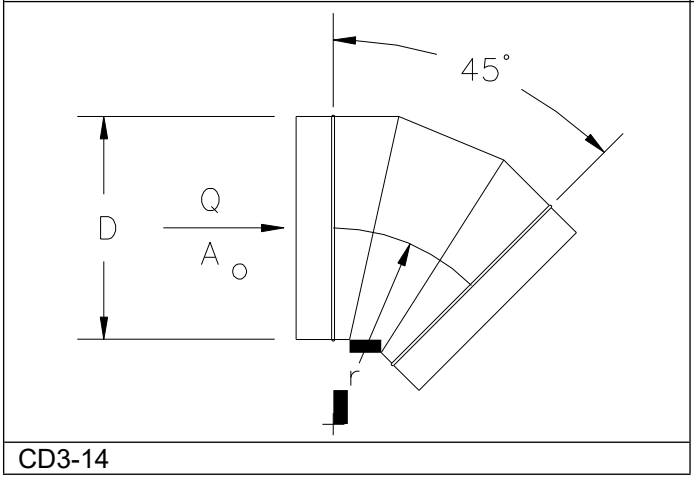

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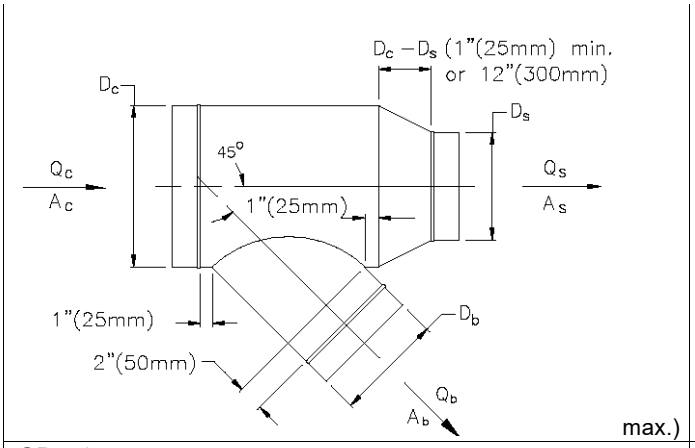
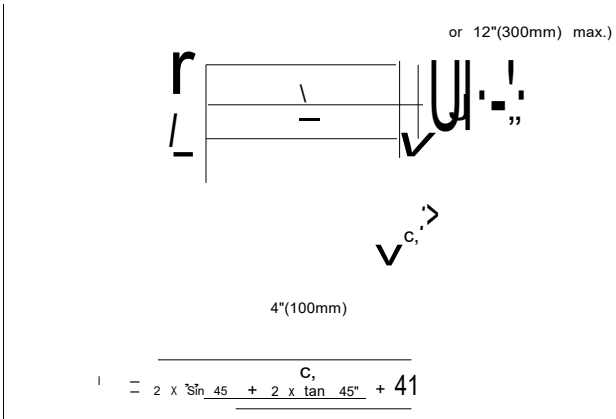


SD5-1



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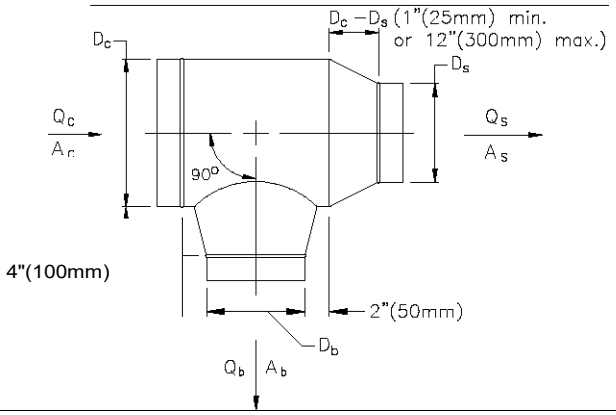

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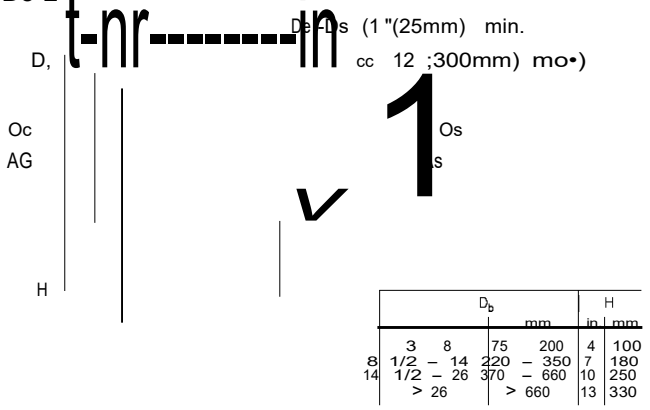
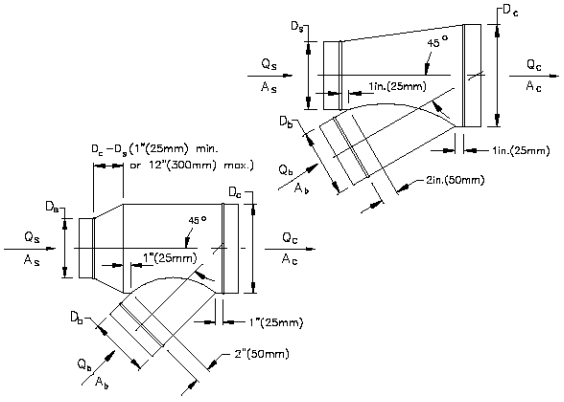


Db				H	
		mm		in	mm
3	8	75	200	4	100
8	1/2 – 14	220	– 350	7	180
14	1/2 – 26	370	– 660	10	250
> 26		> 660		13	330

SD5-12



ED5-2

END OF SECTION

ACOUSTIC LINING (DUCTWORK & PLENUMS)
23 32 48

1 GENERAL

1.1 Scope

.1 Acoustic lining shall only be used in transfer ducts unless otherwise noted.

2 PRODUCTS

2.1 Duct liner - glass fiber

.1 fibrous glass duct liner density 24 kg/m^3 (1.5 lb/cu ft) with one side coated with acrylic coating and flexible glass cloth reinforcement.

.2 flame spread rating not to exceed 25, smoke development rating not to exceed 50.

.3 for rectangular ductwork use 25 mm (1 in) rigid liner,

.4 for plenums and casings use 50 mm (2 in) of fibrous glass rigid board duct liner.

.5 for round or oval ductwork and curved surfaces use 25 mm (1 in) of fibrous glass blanket liner.

Standard of Acceptance
- Manville - Linacoustic RC
- Knauf E-M

2.2 Adhesive

.1 flame spread rating not to exceed 25, smoke developed rating not to exceed 50,

.2 temperature range- 40°C to 82°C (- 40°F to 180°F),

.3 meet requirements of NFPA 90A.

Standard of Acceptance
- Armacell 520 Adhesive
- DuroDyne 1A-22
- Foster
- S.M. Adhesives
- Goodloe & Moore - Tuff Bond

2.3 Fasteners

.1 2.0 mm (1/16 in) diameter weld pins,

.2 Length selected to suit thickness of insulation,

.3 32 mm (1¼ in) square Nylon retaining clips.

Standard of Acceptance
- DuroDyne PN series with NC series clips
- Goodloe & Moore - Gemco

2.4 Sealer and tape

.1 Armstrong WB Armaflex Finish, Manville SuperSeal coating, and

.2 Polyvinyl treated open weave fibreglass membrane 50mm (2 in) wide.

Standard of Acceptance
- Duro Dyne FT-2

2.5 Metal liner

.1 0.5 mm (26 ga) galvanized perforated metal liner for ducts where air velocity exceeds 10 m/sec (2000 fpm).

.2 1.6 mm (16 ga), 20 mm x 10 mm (¾ in x d in) flattened expanded metal lath for plenums and casings.

3 EXECUTION

3.1 Installation

.1 Duct size indicated to be size as measured inside liner

.2 Acoustic lining shall only be used in transfer ducts unless otherwise noted.

.3 Fasten liner to interior sheet metal surface of duct with 100% coverage of adhesive, and install weld pins at 1 pin per 0.5m^2 (5 sq ft) but not less than 1 row on each duct side.

.4 Position and adhere sheets to overlap previously installed sheets by 4 mm (1/8 in). After bonding of sheets spread butt joints and brush apply adhesive to both butt edges and apply pressure to joint.

.5 Apply tape to joints, exposed edges, weld pins and clip penetrations and damaged areas of liner.

.6 Bed tape in sealer and apply 2 coats of sealer over tape.

.7 Over acoustic insulation in round or oval ductwork where air velocity exceeds 10 m/sec (2000 fpm) apply perforated metal liner and secure with weld pins and speed washers.

.8 Lining in plenums and casings:

.1 adhered and pinned as for ductwork,

.2 in addition apply flattened expanded metal lath secured with weld pins and speed-washers over liner and fasten 50 mm (2 in) edge nosings crimped from 1 mm (20 ga) galvanized corner angles at leading and trailing edges of liner.

.9 Provide expanded metal mesh over acoustic lining in accessible ductwork and on casing and plenum roofs walls and floors.

END OF SECTION

DUCT ACCESSORIES 23 33 05

1 GENERAL

1.1 Scope

.1 Provide duct accessories as shown.

1.2 Shop drawings

.1 Submit product data sheets for:

.1 flexible connections

.2 sealants

.3 tapes

.4 duct access doors and hardware

.5 instrument test ports

2 PRODUCTS

2.1 Flexible connections

.1 Neoprene:

.1 galvanized 0.66 mm (24 ga) sheet metal frame, with fabric clenched with double locked seams,

.2 fire resistant, self-extinguishing, neoprene coated glass fabric,

.3 operating temperature: -40°C to 90°C (-40°F to 194°F),

.4 density: 0.653 kg/m^2 (0.13 lb/sq ft) in conventional systems.

Standard of Acceptance
- Duro-Dyne - Durolon
- Ventfabric - Ventglas
- Elgin - Neoprene

.2 Vinyl coated, insulated:

.1 flame resistant, 0.56 mm (0.022 in) thick vinyl coated fabric envelope, enclosing 32mm (1¼ in),12kg/m^3 (0.75 lb/cu ft) fiberglass insulation,

.2 operating temperature: 82°C (180°F) continuous and 93°C (200°F) intermittent,

.3 installed;

(a) in connections for insulated duct systems,
(b) in circular duct connections subject to negative pressure with diameter less than 250mm (10 in), and
(c) in rectangular duct connections subject to negative pressure with smallest side less than 300mm (12 in)

Standard of Acceptance
- Duro-Dyne - Insulflex

2.2 Sealant

.1 water based polymer emulsion type flame resistant duct sealing compound.

.2 operating temperature range: -29°C to 93°C (-20°F to 200°F).

Standard of Acceptance
- Bakor 530 - 14
- RCD #6
- 3M Fastbond 900
- Childers CP-145a & CP-146
- United Duct Sealer (water based)
- Duro Dyne DWN (water based)

2.3 Tape

.1 polyvinyl treated open weave glass fibre tape, 50mm (2") wide.

Standard of Acceptance
- Duro-Dyne FT-2

2.4 Duct access doors

.1 Construction - uninsulated duct or plenum:

.1 shop or field fabricated from same material as duct, one sheet metal thickness heavier but not less than 0.6mm (26ga.) thick,

.2 with gasketed sheet metal angle frame.

.2 Construction - insulated duct or plenum:

.1 shop fabricated as double wall insulated sandwich, of same material as duct, one sheet metal thickness heavier but not less than 0.6mm (26ga) thick,

.2 with gasketed sheet metal angle frame and 25 mm (1 in) thick rigid glass fibre insulation.

.3 gasketed with neoprene or foam rubber.

.4 fitted with hardware as follows: two sash locks for doors up to 300 mm x 300 mm (12 in x 12 in).

.1 four sash locks for doors up to 301 mm x 450 mm (13 in x 18 in).

.2 piano hinge and minimum 2 sash locks for doors up to 451 mm x 1000 mm (19 in x 40 in)

.3 piano hinge and 2 handles operable from both sides for doors over 1000 mm (40 in) in height.

Standard of Acceptance
- Duro-Dyne SP-21 for door handles

2.5 Instrument test ports

.1 Construction:

.1 1.6 mm (16 ga.) thick steel body zinc plated after manufacture,

.2 chain secured neoprene expansion plug with cam lock handle,

.3 28 mm (1 in) minimum inside diameter, length to suit insulation thickness,

.4 Neoprene mounting gasket: flat for rectangular duct and moulded for round duct.

Standard of Acceptance
- Duro-Dyne IP1 or IP2

3 EXECUTION

3.1 Flexible connections

.1 Provide to isolate air handling equipment, fans, ductwork, and as shown.

.2 Minimum length: 75 mm (3 in) length of fabric measured in direction of air flow,

.3 Minimum distance between metal parts when system is in operation: 25 mm (1 in).

.4 Anchored on static side of connection.

3.2 Sealant and tape

.1 Apply to ductwork joints and seams as detailed in other sections.

3.3 Access doors

.1 Install in ductwork;
- .1 before and after reheat coils, and at
- .2 fire dampers,
- .3 duct smoke detectors,
- .4 volume control devices, and
- .5 control elements.

.2 Weld door frames in place for plenums, casings, and high velocity ductwork.

.3 Door sizes:
- .1 as large as possible, with 1:1.5 aspect ratio, for duct sides up to and including 360 mm (14 in),
- .2 300 mm x 380 mm (12 in x 15 in) for duct sides 380 mm (15 in) and larger,
- .3 1500 mm (60 in) high by 450 mm (18 in) wide in casings and plenums.

3.4 Instrument test ports

.1 Install for duct velocity traverse readings and for duct air temperature readings.

.2 Locate across duct or plenum at right angles to flow, at not more than 250 mm (10 in) intervals for traverses and at not more than 500 mm (20 in) for temperature measurements.

.3 Install for velocity traverses;
- .1 at ducted inlets to roof and wall exhausters,
- .2 at inlet to and outlet from other fan systems, and
- .3 at main and branch where branch serves more than one outlet. Ports in main to be upstream of branch in both diverging and converging flow.

.4 Install for temperature measurement;
- .1 at outside air intakes,

.2 at inlet and outlet of coils, and

.3 downstream of intersection of converging air streams of different temperatures.

END OF SECTION

DAMPERS - BALANCING
22 33 13

1 GENERAL

1.1 Scope

.1 Provide balancing dampers at every main, sub-main, branch-main and branch ducts (definitions as per ASHRAE systems hand book) and at locations required to perform testing, adjusting & balancing. Additionally, provide balancing dampers at locations shown.

2 PRODUCTS

2.1 Splitter dampers

.1 Construction:

.1 single thickness construction, of same material as duct but one sheet metal thickness heavier where both dimensions of damper blade are less than 300 mm (12 in),

.2 double thickness construction, one metal thickness lighter than duct, where either dimension of damper blade is 300 mm (12 in) or larger,

.3 of height equal to full depth of branch duct and length 1½ times branch duct width.

.4 fitted with piano hinge pivot, control rod, and locking device accessible from outside fitting.

2.2 Single blade dampers in rectangular ductwork

.1 Construction:

.1 shop fabricated of same material and sheet metal thickness as duct, stiffened with longitudinal V- grooves.

.2 maximum aspect ratio: 3:1,

.3 maximum blade height: 250 mm (10 in).

.4 fitted with locking quadrant and inside and outside bearings.

2.3 Multi-blade dampers in rectangular ductwork

.1 Construction:

.1 shop fabricated of same material and sheet metal thickness as duct, stiffened with longitudinal V- grooves.

.2 opposed blade configuration

.3 channel frame with angle blade stop,

.4 maximum blade height: 100 mm (4 in),

.5 maximum blade length: 1200 mm (48 in).

.6 bearings with bronze bushings.

.7 shaft extension with locking quadrant.

2.4 Single blade dampers in round ductwork

.1 Construction:

.1 shop fabricated butterfly type with round edged 3.5 mm (10 ga) disk set in round sheet metal housing, fitting snugly when closed, 10 degrees from vertical,

.2 fitted with rubber packing glands, shaft extension, wing nuts, and indexing device to indicate disk position.

3 EXECUTION

3.1 Manual dampers

.1 Install dampers:

.1 Provide balancing dampers at every main, sub-main, branch-main and branch ducts (definitions as per ASHRAE systems hand book) and at locations required to perform testing, adjusting & balancing. Additionally, provide balancing dampers at locations shown.

.2 Install splitter dampers and single or multiple blade dampers where branches are taken from or feed into main ducts as specified above.

.3 Provide other manual dampers as shown.

3.2 Access for adjustment

.1 Locate dampers to allow adjustment of blade position and locking of quadrant and for servicing damper actuators on motorized dampers.

END OF SECTION

DAMPERS - OPERATING
23 33 14

1 GENERAL

1.1 Scope

.1 Provide motorized dampers as shown.

1.2 Related sections

.1 Dampers complying with this section:

.1 25 35 01: B.A.S. Instrumentation and Actuators

1.3 Shop drawings and product data

.1 Submit manufacturer's catalogue literature with:

.1 performance charts, pressure drop vs approach velocity for range of blade angles from 0 to 90°

.2 torque requirements.

.3 construction details.

2 PRODUCTS

2.1 Multi-leaf dampers

.1 Parallel blade type:

.1 for two position, OPEN/CLOSED, service

.2 for modulating fresh and return service in air handling units.

.2 Opposed blade type

.1 for other modulating service.

.3 Performance:

.1 leakage in closed position: maximum 2% of rated air flow at 500Pa (2 in wg) differential across assembly,

.2 pressure drop in open position: maximum 50 Pa (0.2 in wg) differential at 5 m/s (1000 fpm).

.4 Construction:

.1 blades, non-insulated: extruded aluminum interlocking blades,

.2 frame, non-insulated: extruded aluminum,

.3 blades, insulated: extruded aluminum interlocking double thickness insulated blades,

.4 frame, insulated: extruded aluminum, thermally broken,

.5 seals: extruded vinyl seals, and spring stainless steel side seals,

.6 maximum blade width: 125 mm (5 in),

.7 maximum blade length: 1200 mm (4 ft).

.8 self-lubricated bronze bearings.

.9 blade linkage with steel tie rods, brass pivots and steel brackets.

.5 Actuator:

.1 24 Volt electric actuator with spring return, stroking damper from closed to open with 4 -20 mA signal.

Standard of Acceptance
- Belimo - electric actuators

3 EXECUTION

3.1 Installation

.1 Secure dampers within ductwork, air handling units and at air inlets an exhaust outlets, and as shown.

.2 Caulk around frames and between multiple damper modules with UL listed silicone-free sealant.

END OF SECTION

DAMPERS - FIRE AND SMOKE
23 33 15

1 GENERAL

1.1 Scope

.1 Provide fire and smoke dampers as shown.

1.2 Shop drawings and product data

.1 Submit manufacturers' product sheets with installation data for:

.1 Fire dampers.

.2 Smoke dampers.

.3 Combination smoke and fire dampers.

1.3 Applicable codes and standards

.1 General:

.1 AMCA 500 Laboratory Methods of Testing Dampers for Ratings.

.2 AMCA 503 Fire Ceiling (Radiation), Smoke, and Fire/Smoke Dampers Application Manual.

.2 Listings:

.1 ULC, UL or Warnock Hersey listed to:

(a) CAN/ULC - S112 Standard Method of Fire Test of Fire Damper Assemblies
(b) CAN/ULC - S112.1 Standard for Leakage Rated Dampers for Use in Smoke Control Systems
(c) CAN/ULC - S112.2 Standard Method of Fire Test of Ceiling Firestop Flap Assemblies

.3 Field Testing:

.1 NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems

.2 NFPA 80 Standard for Fire Doors and Other Opening Protectives

.3 NFPA 105 Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives

1.4 Definitions

.1 Static damper: means a damper rated only to close with essentially no airflow through damper.

.2 Dynamic damper: means a damper rated to close with air flow through damper at specified air velocities and operating pressure.

2 PRODUCTS

2.1 Fire dampers - general

.1 Curtain damper styles:

.1 Type A: blade pack and frames in airstream,

.2 Type B: blade pack out of airstream,

.3 Type C: blade pack and frame out of airstream; for rectangular, round and flat oval ductwork; and sleeve joints and damper/sleeve joints sealed.

.2 Fire damper fire-resistance rating:

.1 Fire separation ratings 2 hr and less: 1-1/2 hrs

.2 Fire separation rating 3 hr or more: 3 hr.

.3 Ratings, dynamic dampers:

.1 standard performance

(a) air velocity, maximum 10 m/s (2000 fpm)
(b) operating static pressure, maximum 1000 Pa (4 in wc.)

.2 extended performance (“EPxx”)

(a) air velocity, maximum 15 m/s (3000 fpm)
(b) operating static pressure, maximum 1000 Pa (4 in wc.)

.3 high velocity performance (“HVxx”)

(a) air velocity, maximum 20 m/s (4000 fpm)
(b) operating static pressure, maximum 1000 Pa (4 in wc.)

.4 Manufacturers:

Standard of Acceptance
- Nailor
- EH Price (National Controlled Air)
- Ruskin

2.2 Fire dampers - curtain type

.1 Construction:

.1 frame: G60 roll formed galvanized steel frame,

.2 blades: curtain type, interlocking blades, G60 galvanized steel,

.3 sleeve:

(a) same material as damper frame, length to suit application with steel enclosure and transition collars, and retaining angles.
(b) for type B damper sleeves, top of sleeve is formed closely around top of damper; sleeve construction that leaves the blade pack in the airstream is not permitted.

.4 sleeve type: type A, B, and C as shown.

.5 fusible link: 71°C (160°F) unless otherwise shown.

.6 notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.

.7 dynamic dampers: fitted with stainless steel closure spring, and rated for velocity and operating pressure based on type.

.8 static dampers: fitted with stainless steel closure spring.

2.3 Fire dampers - airfoil multiblade type

.1 Construction:

.1 type: dynamic,

.2 frame: G60 galvanized steel hat channel,

.3 blades: airfoil multiblade type, opposed or parallel action, interlocking blades, G60 galvanized steel,

.4 linkage: concealed in frame (out of airstream),

.5 jackshaft: with internal locking quadrant, for use as a balancing damper,

.6 sleeve: same material as damper frame, length to suit application with steel enclosure and transition collars, and retaining angles,

.7 sleeve type: type A, B or C as per listing requirements.

.8 fusible link: high torque spring/fusible link, 71°C (160°F) unless otherwise shown.

.9 notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.

.2 Operator, electric:

.1 where required

(a) by listing for multiple damper installations and
(b) where otherwise shown for single and multiple damper installations.

.2 factory installed electric two position, fail close, operator, 120 VAC

motor, (a) primary electric thermo-switch : 71°C (160°F),
(b) secondary electric resettable link: 121°C (250°F), with manual reset button, (c) controlled rate spring closure.
(d) maximum power: 25 VA opening, 12 VA holding.

2.4 Smoke dampers

.1 Construction:

.1 type: dynamic,

.2 frame: G60 galvanized steel hat channel, with stainless steel jamb seals,

.3 blades: airfoil multiblade type, parallel action, interlocking blades, 6063-T5 extruded aluminum, with silicone blade seals,

.4 linkage: exterior side of frame (out of airstream),

.5 sleeve: same material as damper frame, length to suit application with steel enclosure and transition collars, caulked joints, and retaining angles,

.6 sleeve type: type A, B or C as per listing requirements.

.7 fusible link: high torque spring/fusible link, 71°C (160°F) unless otherwise shown.

.8 leakage rating: Class I at 120°C (250°F).

.9 notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.

.2 Operator, electric:

.1 factory installed electric two position, fail close, operator, 120 VAC

motor, (a) primary electric thermo-switch : 71°C (160°F),
(b) secondary electric resettable link: 121°C (250°F), with manual reset button, (c) controlled rate spring closure.
(d) maximum power: 25 VA opening, 12 VA holding.

.3 Damper position switch:

.1 factory installed, damper position contact switches,

(a) prove damper open,
(b) prove damper closed.

2.5 Combination smoke and fire dampers

.1 Construction:

.1 type: dynamic,

.2 frame: G60 galvanized steel hat channel, with stainless steel jamb seals,

.3 blades: airfoil multiblade type, opposed action, interlocking blades, G60 galvanized steel,

.4 linkage: concealed in frame (out of airstream),

.5 sleeve: same material as damper frame, length to suit application with steel enclosure and transition collars, caulked joints, and retaining angles,

.6 sleeve type: type A, B or Cas per listing requirements.

.7 notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.

.2 Operator, electric, re-openable:

.1 factory installed, electric two position, fail close, operator, 120 VAC

motor, (a) re-opendable damper control system,
(b) primary electric thermo-switch : 71°C (160°F),
(c) secondary electric resettable link: 121°C (250°F), with manual reset button, (d) controlled rate spring closure.
(e) maximum power: 25 VA opening, 12 VA holding.

.3 Damper position switch:

.1 factory installed, damper position contact switches,

(a) prove damper open,
(b) prove damper closed.

3 EXECUTION

3.1 Fire dampers and fire stop flaps

.1 Install fire dampers and fire stop flaps throughout supply, return and exhaust air systems..

.2 Install fire dampers in accordance with manufacturer's instructions, with sleeve, duct connections and angle supports to comply with terms and conditions of listing or classification and maintain integrity of fire wall and/or fire separation.

.3 Install fire dampers at all fire separations. Refer to Architectural fire separation drawings.

3.2 Fire damper selection

.1 Select fire damper types as follows:

.1 “Dynamic” - all locations unless otherwise shown,

.2 “Static” - restricted to un-ducted transfer air openings only where shown.

.2 Select curtain fire damper styles as follows:

.1 For dynamic and static dampers:

(a) duct height is duct dimension perpendicular to blade length orientation.

Damper Velocity Class	Duct Height mm	Curtain Damper Style
Standard Performance (≤ 10 m/s)	> 300	A
	≤ 300	B
Extended Performance (≤ 15 m/s)	> 200	B
	≤ 200	C
High Velocity Performance (≤ 20 m/s)	Any	C

Damper Velocity Class	Duct Height In.	Curtain Damper Style
Standard Performance (≤ 2000 fpm)	> 12	A
	≤ 12	B
Extended Performance (≤ 3000 fpm)	> 8	B
	≤ 8	C
High Velocity Performance (≤ 4000 fpm)	Any	C

3.3 Fire damper installation

.1 Install individual fire dampers and/or assemblies of individual fire dampers within limitations of listing or classification.

.2 Where size of duct exceeds the maximum listing size of a multiple curtain damper assembly, provide multiblade dampers.

.3 Where fire dampers are shown to be motorized, provide multiblade fire damper with electric operator.

.4 Install stainless steel dampers in stainless steel duct systems and/or wherever ductwork is specified to be watertight construction.

.5 Position duct access door at each fire damper, to permit visual inspection and replacement of fusible link.

.6 Install fire stop flaps in accordance with manufacturers' instructions to comply with terms and conditions of listing or classification. Position supplied thermal blankets to cover ceiling diffusers.

3.4 Smoke dampers and combination smoke/fire dampers

.1 Install smoke dampers and combination smoke and fire dampers, with leakage class as indicated, throughout supply, return and exhaust air systems as shown. Provide low pressure loss dampers where indicated.

.2 Install individual dampers and/or assemblies of individual dampers within limitations of listing or classification.

.3 Where combination smoke and fire dampers are shown in stainless steel or watertight duct systems, install stainless steel interlocking blade fire damper and separate smoke damper constructed to listed or classified leakage rating, but with stainless steel blades.

.4 Install and connect damper operators to achieve smoke control and smoke venting sequences as shown.

3.5 Damper sleeves

.1 Provide factory damper sleeves in accordance with damper listing requirements, and as described herein.

.1 For type “B” curtain fire dampers, fabricate the sleeve to keep the folded-blade stack out of the air stream, by forming that portion of the sleeve to wrap-around the blade stack to eliminate air pockets on the entering and leaving side of the damper.

.2 For multiblade dampers, smoke dampers, and combination smoke/fire dampers fabricate sleeve style based on damper size listing requirements.

.2 Install damper sleeves with retaining angles in accordance with the damper listing instructions.

3.6 Damper Access

.1 Position duct access door at each fire damper, to permit visual inspection and replacement of fusible link.

.1 for horizontal dampers, preferred access location is from the floor above the damper.

.2 Position duct access door at each combination fire and smoke damper, to permit visual inspection and service of detection/actuation mechanism.

.3 Provide similar access door upstream or downstream of each smoke damper for visual inspection.

3.7 Power for multiblade fire and smoke damper actuators

.1 Power for smoke dampers and combination smoke/fire dampers will be provided under Division 26.

.2 Power for fire dampers specifically designated as motorized fire dampers will be provided under Division 26.

.3 Where a multiblade fire damper assembly requires an electric actuator because of its listing but not otherwise designated as a motorized fire damper, provide power and conduit from nearest normal designated 120 VAC power distribution panel.

.1 provide 15 A breaker, with tamper lock, for each circuit,

.2 maximum number of actuators on each electrical circuit: 5 A,

.3 each circuit only to serve dampers located on the same floor as the power distribution panel.

3.8 Testing

.1 Field test all fire dampers, smoke dampers, combination smoke/fire dampers and fire stop flaps as follows:

.1 operate dampers to demonstrate unobstructed operation of the damper from open-to-close-to open state. These tests are to be performed while the fan systems are not in operation (static test).

.2 for dynamic dampers, confirm air velocity through the open dampers under normal HVAC system operation, once air balancing is completed. Dampers may be selected as appropriate to confirm operation for ducts operating within 80% of the maximum air velocity of the damper listing.

.3 confirm accessibility to components of fire damper to permit maintenance and testing.

.4 where a damper is provided with an indicating device, confirm device functions and annunciates to the supervised location or system when the damper is in both the open and closed state, as applicable.

.2 In addition, for multiblade fire dampers with electric operators, smoke dampers or combination smoke/fire dampers, cycle test dampers under normal HVAC operating conditions (dynamic test).

.3 Record test results as per the attached test form or similar containing the same information, and submit to Owner and Engineer as part of the Operations and Maintenance manual.

.4 Upon completion of testing, provide labour and resources necessary to re- test up to 10% of dampers on each floor as selected and witnessed by Engineer.

END OF SECTION

Test form follows

Fire, Smoke, and Fire/Smoke Damper Test Record

Project	System
Testing Company	Technician Name

Damper location	Inspection Date YYYY-MM-DD	Damper Type(1)	Static Op. Test(2)	Dyn Op. Test(3)	Access Test (4)	Air Flow(5)	Confirmed/ Deficiencies	Deficiency Corrected	Damper Audited

(1) Damper Type : FC, SD, or CSFD
(2) Static Operating Test without airflow
(3) Dynamic Operating Test with balanced airflow; multiblade FD, SD and CSFD only. (4) Damper and components are accessible for inspection and testing
(5) Identify which damper air velocity is checked in accordance with the test selection criteria.

DUCT SILENCERS
23 33 19

1 GENERAL

1.1 Scope

.1 Provide sound attenuation as shown in accordance with ASTM E477, ASTM E90 and ASTM C423, selected to maintain noise levels in areas of building as follows:

AREA	NOISE CRITERIA (NC level)
Offices - private	32 to 34
- open plan	36 to 38
Labs - General	34 to 38
Classrooms & Lecture Halls	30 to 32
Corridors	36 to 38
Conference/Boardrooms	30 to 32
Public Areas	38 to 40

.2 Provide shop drawing or product data sheet for each piece of attenuation equipment.

.3 Provide performance rating data on silencers and acoustic plenums, certified by Professional Engineer and supported by test results in accordance with referenced standards as follows

.1 Silencer; Insertion loss, pressure drop.

1.2 Applicable codes and standards

.1 ASTM E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner
Material and Prefabricated Silencers

.2 ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.3 ASTM C423 Standard Test method for Sound Absorption and Sound Absorption Coefficients by the
Reverberation Room Method

.4 ASTM C 739 Standard Specification for Cellulosic Fiber Loose-fill Thermal Insulation

.5 ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy- Coated (Galvannealed) by the Hot-Dip Process

.6 Sheet Metal and Air Conditioning Contractors National Association (SMACNA) material and fabrication specifications.

2 PRODUCTS

2.1 Silencers

.1 Factory manufactured of galvanized or prime painted steel, meeting SMACNA material standards.

.2 Construction:

.1 0.8 mm (22 ga) minimum outer shell with airtight mastic filled seams for rectangular low velocity applications up to 10 m/s (2000 fpm),

.2 1.6 mm (16 ga) welded outer shell for rectangular high velocity application over 10 m/s (2000 fpm) and for circular units 600 mm (24 in) diameter and larger,

.3 1.2 mm (18 ga) welded outer shell for circular units of less than 600 mm (24 in) diameter,

.4 50 mm (2 in) slip connections, and lifting lugs, and

.5 acoustic media.

.3 Fittings:

.1 inner casing minimum 0.8 mm (22 ga) perforated metal, enclosing acoustic media, and

.2 media erosion protection of mold resistant cloth between media and perforated metal, where airflow gap velocity exceeds 22.5 m/s (4500 fpm).

Standard of Acceptance
- EH Price
- Vibro-Acoustics
- Vibron
- Korfund
- IAC

3 EXECUTION

3.1 Installation

.1 Install sound attenuation equipment in accordance with manufacturer's instructions

3.2 Manufacturer's inspection

.1 On completion of installation and start-up of equipment;

.1 make arrangements for manufacturer/supplier of Sound Attenuation equipment to visit site, check performance of noise attenuation systems, inspect installation and submit written recommendations.

.2 make corrections to installation in accordance with manufacturer/suppliers recommendations.

.3 provide notice 24 hours in advance of this site visit.

3.3 Testing

.1 Engage and pay for an experienced sound and vibration professional to take measurements of sound generated by HVAC systems.

.2 Co-operate with manufacturer/supplier of Vibration Isolation equipment in this measurement and testing.

.3 Sound measurements to extend over full audio frequency range and to be taken in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and main electrical rooms.

.4 Submit outline of tests to be performed, details of instrumentation to be used and floor plans showing test locations prior to commencing work.

.5 Provide notice one week in advance of commencement of tests.

.6 Submit complete report of tests addressing noise levels measured in occupied areas and adequacy of Sound Attenuation and Vibration Isolation equipment.

END OF SECTION

TERMINAL BOXES
23 36 13

1 GENERAL

1.1 Scope

.1 Provide terminal boxes as shown.

1.2 Shop drawings

.1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, enclosure details, support and connection arrangements and electrical power requirements where applicable.

1.3 Applicable codes and standards

.1 ARI Standard 880 Standard for Air Terminals

.2 ARI Standard 885 Standard for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

.3 ASHRAE Standard 180 Methods of Testing for Rating Ducted Air Terminal Units

2 PRODUCTS

2.1 General

.1 Selection of units to meet air quantities shown to be based on;

.1 maximum Inlet Air Pressure; 750 Pa (3 in wg),

.2 minimum Inlet Air Pressure; 75 Pa (0.3 in wg),

.3 maximum room NC sound pressure level (2×10^{-4} microbar reference) at maximum inlet pressure to be less than 40 at discharge and 42 radiated for box with attenuator mounted exposed (without ceiling).

.2 Where sizes, model numbers and unit types are indicated, selections are taken from E.H. Price catalogue.

Standard of Acceptance
- EH Price
- Titus

2.2 Terminal box

.1 Construction:

.1 pressure independent type with pneumatic velocity sensor, damper assembly, factory calibrated controller and actuator with adjustable minimum stop

.2 damper arranged "normally open" for morning warm-up.

.3 controller capable of maintaining air quantity within ±5% of set value, between zero and stipulated rated air flow,

.4 sound level below specified values when operating from minimum to maximum inlet static pressure.

.2 All supply air terminals shall be industrial grade and constructed of 22-gauge galvanized steel with mechanically locked and gasketed seams.

.3 Provide controls enclosure for each box suitable in size for the DDC controls application including airflow sensors.

.4 Provide 120/24-volt control transformer in each new box.

.5 Silencer/attenuator:

.1 For boxes up to Size 10, provide 0.9m (3 ft) integral discharge attenuator.

.2 For boxes larger than Size 10, provide 1.5m (5 ft) integral discharge attenuator.

.6 acoustic lining - fibreglass:

.1 25 mm (1 in) thick, 64kg/m^3 (4 lb/sq ft) density, rigid fibreglass with fire resistive reinforced aluminum foil-scrim-kraft (FSK) facing,

.2 flame spread rating not to exceed 25, smoke development rating not to exceed 50,

.3 fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m^2 (2 sq ft) but not less than 1 row on each duct side.

.4 edges concealed by metal nosings at inlet and discharge, with notch and tuck fabrication and seams protected by Z strips

Standard of Acceptance
- Steri-Liner

.5 duct liner fasteners:

(a) 2.0 mm (1/16 in) diameter pins,
(b) length selected to suit thickness of insulation,
(c) 32 mm (1¼ in) square Nylon retaining clips.

2.3 Reheat boxes

.1 Construction:

.1 terminal units as specified above,

.2 outlet end of attenuator fitted with serpentine hot water reheat coils;

(a) copper tube, aluminum fin construction in galvanized steel casing,
(b) water side minimum working pressure 860 kPa (125 psi),

.3 access doors in attenuator section upstream of reheat coil.

2.4 Fan powered boxes

.1 Construction:

.1 reheat units or terminal units as specified above

.2 fitted with supply fan and supply/return air mixing arrangement capable of modulating from 100% cold air to 100% return air.

.3 statically and dynamically balanced forward curved fans with sleeve bearings, and brushless DC electronically commutated motor (ECM) with permanent magnet rotor and motor control package for single phase 120 VAC 60Hz power supply.

.2 All supply air terminals shall be industrial grade and constructed of 22-gauge galvanized steel with mechanically locked and gasketed seams.

.3 Provide controls enclosure for each box suitable in size for the DDC controls application including airflow sensors.

.4 Provide 120/24-volt control transformer in each new box.

.5 Silencer/attenuator:

.1 For boxes up to Size 10, provide 0.9m (3 ft) integral discharge attenuator.

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.3 fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m^2 (2 sq ft) but not less than 1 row on each duct side.

.4 edges concealed by metal nosings at inlet and discharge, with notch and tuck fabrication and seams protected by Z strips

Standard of Acceptance
- Steri-Liner

.5 duct liner fasteners:

(a) 2.0 mm (1/16 in) diameter pins,
(b) length selected to suit thickness of insulation,
(c) 32 mm (1¼ in) square Nylon retaining clips.

2.5 Controllers

.1 Direct Digital Controllers (DDC) including actuators to be supplied by Section 25 14 00, B.A.S. Equipment Controllers, and factory mounted by Terminal Box Manufacturer. Costs associated with receiving, storage, installation and calibration to be included by Terminal Box Manufacturer.

.2 Air flow sensor to be provided by Terminal Box Manufacturer.

.3 120 VAC to 24 VAC transformer for DDC controller to be supplied by Section 25 14 00, B.A.S. Equipment Controllers, and factory installed by the Terminal Box Manufacturer.

.4 For rooms 1162, 1159 and 1161, provide full feature thermostat with space temperature adjustment and space temperature, humidity and CO2 monitoring. For all other spaces provide sensor with space temperature monitoring and adjustment capabilities.

3 EXECUTION

3.1 Box installation

.1 Support terminal boxes from building structure with angles, hangers and supplementary steel complete with vibration isolator before installation of piping and connecting ductwork.

.2 Provide access door in ductwork downstream of reheat coil.

3.2 Ductwork connections

.1 Connect inlet ductwork with spiral flat seam round duct of same diameter as terminal box inlet

.2 Support outlet ductwork independent from box.

.3 Seal openings in box and attenuator for reheat coil and connections, control, and power wiring.

3.3 Piping connections

.1 Connect supply and return piping to reheat boxes

.2 Install isolating valve on supply and lock shield ball valve and automatic control valve on return of each reheat coil.

.3 Provide screw driver air vent at high point of piping to each coil.

3.4 Electrical connections

.1 Electrical Division 26 will provided 120 Volt, single phase power supply with a junction box for each group of terminal boxes with maximum of 12 terminal box controls fed from one junction box.

.2 Extend power supply from these junction boxes and connect to terminal units.

3.5 Leakage testing

.1 Terminal boxes and attenuators to be included in ductwork leakage testing.

END OF SECTION

GRILLES, REGISTERS AND DIFFUSERS
23 37 13

1 GENERAL

1.1 Scope

.1 Provide grilles, registers, and diffusers as shown.

1.2 Shop drawings

.1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, support recommendations and connection details.

2 PRODUCTS

2.1 General

.1 Grilles, registers and diffusers:

.1 product of one manufacturer where same model or type identification is used.

.2 standard catalogue products selected to meet capacity, throw, and noise level.

.3 prime coated, stamped or cold rolled steel material with mitred corners and exposed joints welded and ground smooth.

.4 extruded satin finish, clear anodized aluminum material with mitred corners and mechanical fasteners.

.5 Frames with full perimeter gaskets, plaster stops where set into plaster or gypsum board, and concealed fasteners.

2.2 Type designations

.1 Diffuser, register and grille schedule identifies model or type identifiers used on floor plans with model numbers taken from listed manufacturer's catalogue.

.2 Where several manufacturer's model numbers are given, these are acceptable alternatives.

.3 Where only one manufacturer's model number is given, provide designated item.

Standard of Acceptance
- E.H.
- Titus
- Nailor

2.3 Supply registers

.1 double deflection style with face bars vertical and rear bars horizontal,

.2 perimeter border with gasket,

.3 opposed blade dampers (OPD) with concealed manual operator,

.4 of steel or aluminum material.

2.4 Return and exhaust grilles

.1 single deflection type, with horizontal face bars, 20 maximum turn up,

.2 perimeter border with gasket,

.3 opposed blade damper with concealed operator,

.4 of steel or aluminum material.

2.5 Diffusers

.1 circular or square plaque face type, with adjustable pattern control,

.2 of steel or aluminum material.

2.6 Linear diffusers

.1 Type: Extruded aluminum, continuous linear slot with extruded aluminum pattern controller.

.2 Frame: To match ceiling construction.

.1 All linear diffusers installed in gypsum ceilings shall have concealed frames.

.3 Fabrication: Aluminum extrusions .062 inch thick with end-caps, mitered corner and blank-offs for a continuous appearance.

.4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

3 EXECUTION

3.1 Layout

.1 Drawings showing position of air distribution outlets are essentially diagrammatic. Coordinate exact location of diffusers with other elements in ceiling and shown on reflected ceiling drawings and select trim to suit ceiling materials listed in Finish Schedules.

.2 Cut tiles, provide new tiles and tee-bar for installation of air inlets/outlets.

3.2 Special installations

.1 Grilles, registers and diffusers penetrating fire walls and fire partitions, to have steel sleeves secured to structure in accordance with NFPA 90A-1985.

.2 In gymnasium provide safety chain on each diffuser face and core and bolt diffuser in place.

.3 For laminar flow diffusers, with or without HEPA filters, support diffuser from the building structure with steel cable, independent of ceiling system and ductwork.

.4 For security grilles and diffusers, and other grilles and diffusers exceeding 5 kg (12 lbs) weight, mechanically fasten grille/diffuser to ceiling or wall structure, independent of ductwork connection or support.

3.3 Installation of grilles and registers

.1 Install supply registers with face bars vertical and exhaust and return registers with face bars horizontal.

.2 Install registers and grilles with oval head cadmium plated screws in countersunk holes where fastenings are visible.

.3 Ducted exhaust/return registers shall be provided with a minimum 4" high plenum with transition/duct collar for duct connection.

3.4 Installation of diffusers

.1 Diffusers to be installed with concealed fastenings.

.2 Round, square and rectangular diffusers to be provided with equalizing deflectors, mounted in neck, accessible from diffuser face, with blades oriented at right angles to direction from which air is flowing.

.3 Except for last diffuser on branch, each diffuser installed in underside of supply duct to have extract volume control damper.

.4 Provide cord operated volume damper for all linear diffusers located in gypsum board, luminaire, woodslats and all inaccessible ceilings. Provide damper adjustment through face of air outlet. Provide all hardware and extensions.

END OF SECTION

BUILDING AUTOMATION SYSTEMS GENERAL
25 05 01

1 GENERAL

1.1 Scope

.1 Remove existing pneumatic thermostats and controls. All pneumatic demolition to be conducted by Honeywell

.2 Provide Building Automation System (BAS) with Direct Digital Control (DDC), and Energy Management for building mechanical and electrical systems.

.1 Standard of Acceptance

(a) Siemens

.3 Interface with other microprocessor-based building subsystems including fire alarm systems.

.4 Include software and hardware, wiring, and computing equipment.

1.2 Related Sections

.1 Building Automation System includes Sections:

.1	25 13 01	B.A.S. Building Controllers
.2	25 14 01	B.A.S. Equipment Controllers
.3	25 35 01	B.A.S. Instrumentation and Actuators
.4	25 90 01	B.A.S. Sequence of Operations

1.3 Equipment Supplied for installation under Other Sections

.1 Supply the following equipment for installation under other Sections of Division 20;

.1 automatic control valves,

.2 temperature wells for controllers and sensors provided under this Section,

.3 terminal unit controllers, actuators for volume dampers and velocity pressure sensors including transformers. Arrange and pay for shipping to terminal unit manufacturer's facility for factory installation.

.4 actuators for motorized dampers and smoke dampers including associated end switches and relays.

1.4 Equipment Provided under Other Sections

.1 The following equipment is provided under other Sections of Division 20;

.1 liquid flow measuring devices

.2 steam humidifiers with automatic control valves

.3 unit heater and cabinet unit heater line voltage thermostats

.4 manual dampers, fire dampers, gravity dampers, and smoke dampers.

1.5 Applicable standards

.1 ANSI/ASHRAE standard 135-2001 BACnet

.2 Interfacing Standard:

.1 Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EI (Electronic Industry Association) interfaces.

.2 CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).

.3 IEEE 802.3 Ethernet 10Base-T LAN.

1.6 Abbreviations and definitions

.1 The following definitions, abbreviations, and acronyms apply:

.1	AI	Analog Input: continuously variable value, usually a sensor, referenced to a controller
.2	AO	Analog Output: continuously variable value, usually a control signal to an actuator device, referenced to a controller.
.3	BI	Binary (digital) Input: a two-state (On-Off) value, usually associated with a switch or state, referenced to a controller.
.4	BO	Binary (digital) Output: a two-state (On-Off) value, usually associated with starting or stopping equipment or generating an alarm, referenced to a controller.
.5	BCU	Building Control Unit
.6	ECU	Equipment Control Unit
.7	FAS	Fire Alarm System
.8	GUI	Graphic User Interface: an LED, LCD or monitor display
.9	I/O	Input/Output
.10	LAN	Local Area Network
.11	NC	Normally Closed: position of device in a de-energized state.
.12	NO	Normally Open: position of device in a de-energized state.
.13	OWS	Operator workstation: a PC based server or computer
.14	Tier 1	High level network providing communication between BCU's and workstations.
.15	Tier 2	Lower level network providing communications between ECU's and BCU's
.16	WAN	Wide Area Network

1.7 Manufacturers and Installers

.1 Provide BAS with DDC and Energy management for mechanical and electrical systems by an organization:

.1 specializing in design, installation, commissioning and service of DDC systems,

.2 having completed five (5) projects of similar size and complexity within the preceding five (5) years,

.3 employing certified journeymen experienced in this type of work.

1.8 Continuity of Staff and Subcontractors

.1 Project Manager is to be nominated at time of shop drawing submission and is to remain involved with project, from shop drawing preparation through to Acceptance, unless request for change is submitted and approved.

.2 Subcontractors listed in preliminary design submission are to execute work defined as sublet in preliminary design document, unless request for change is submitted and approved.

.3 Requests for changes in staff, subcontractors, or extent of work subcontracted are to be submitted for approval and such approval is not to be unreasonably withheld.

1.9 Identification of non-conforming materials and equipment.

.1 Submit documentation at time of bid, identifying nature and extent of non-conformance and variances from specifications or referenced standards.

.2 Failure to submit this documentation at time of bid will be interpreted as confirmation that materials, workmanship, hardware and software will be in strict accordance with specifications and standards.

1.10 Licences and Ownership

.1 Ownership of, and licences for, hardware and software supplied or used for this project or for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.

.2 This is applicable to System Software, Workstation Application Editors, and Controller Software.

.1 Licensing to permit an unlimited number of users to access system without additional fees.

.2 As of last day of warranty period, software is to be upgraded to current version or release.

.3 Project-developed software and resulting documentation to be treated as part of system and subject to these same requirements for ownership and licensing. This material includes;

(a) Project graphic images
(b) CAD generated record drawings
(c) Project database
(d) Project-specific application programming code and documentation.

1.11 Shop Drawings

.1 Submit one completely engineered and coordinated shop drawing package. Partial or incomplete submission of data and/or drawings will be returned without review.

.2 Submit shop drawings for designed elements;

.1 list of materials of equipment to be used indicating manufacturer, model number, and other relevant technical data.

.2 BAS riser diagram showing system controllers, operator workstations, and network wiring.

.3 single-line schematics and system flow diagrams showing location of control devices.

.4 points list for each system controller, including: Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Panel, Reference Drawing, and Cable Number.

.5 points to be named by function, and list to include software points such as programmable set- points, range limits, time delays, and so forth.

.6 detailed analysis of each Sequence of Operation from design documents, ready for development of actual programming code.

.7 Sequence of Operations to cover normal operation and operation under various alarm conditions applicable to that system.

.3 Submit shop drawings schedules for;

.1 control damper; spreadsheet type, to include separate line for each damper and columns for damper attributes.

.2 control valve; spreadsheet type, to include separate line for each valve and separate columns for valve attributes.

.4 Submit catalogue cut-sheets for;

.1 manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for equipment and hardware items as follows;

(a) Controllers (BCU's and ECU'S)
(b) Transducers/Transmitters and Sensors with
- accuracy data, range and scale information,
- one sheet for each device marked with applicable options. (Where several devices of same type are to be used, submit one sheet for each device, individually marked.)

(c) Actuators
(d) Valves
(e) Relays/Switches
(f) Panels
(g) Power Supplies
(h) Batteries
(i) Operator Interface
(j) Wiring and wiring accessories

.2 hardware data sheets for Operator Interfaces, local panels, and portable operator terminals.

.5 Submit supporting documentation:

.1 examples of graphics for Operator Interface to include;

(a) BAS network schematics
(b) typical terminal unit floor plan graphic that shows conditions on occupied floor
(c) typical equipment room floor plan graphic
(d) typical graphics for each system and terminal unit at least one sample graphic for each type of equipment,
(e) one sample graphic for chilled water system
(f) one sample graphic for hot water system
(g) description of techniques used for animation of information displayed on graphics.

.2 Software manuals for applications programs for Operator Interface, portable operator terminals, and programming devices.

.3 Protocol Implementation Conformance (PIC) statement for BACnet devices.

.4 Where interfaces occur with control or wiring diagrams of other sections, obtain reproducible copies of these diagrams and revise to show terminal numbers at interface and include diagrams as part of interconnection schematic shop drawings.

1.12 Project schedules

.1 At time of shop drawing submission provide Gantt type Schedule of Work with;

.1 project broken down into discrete work items

.2 start date of each work item

.3 duration of each work item

.4 relationships between work items and showing constraints on work flow.

.5 planned delivery dates for ordered material and equipment with expected lead times.

.6 procedures.

.2 During design, installation and start-up of installation provide monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated Schedule of Work with each report.

1.13 Warranty

.1 At completion of Work, submit written guarantee undertaking to remedy defects in work for period of two (2) years from date of acceptance, which includes:

.1 rectification of control system failures attributable to defects in workmanship, materials, hardware, and software,

.2 Service Technician to arrive on site within 24 hours of warranty service request, to install and de- bug software patches, to replace defective parts, materials or equipment, and to provide incidental supplies, and labour for remedial work,

.3 Technician to remain in attendance until system is returned to operating condition.

.2 Submit similar guarantee for any part of work accepted by Owner, before completion of whole work.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

.1 Temperature - 0°C to 32.2°C (32°F to 90°F)

.2 Relative Humidity 10% to 90% non-condensing

.3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Equipment standard

.1 Products and software: manufacturer/developer/supplier’s catalogued current stock.

.2 This installation is not to be used as test site for newly developed product or software, without explicit written approval.

.3 Equipment and systems installed under this Contract to meet;

.1 performance specifications when subjected to VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes.

.2 Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices.

2.3 General BAS architecture

.1 Control system:

.1 microprocessor based Direct Digital Control (DDC) controllers,

.2 each mechanical system, building floor plan, and control device to be displayed through point- and-click graphics,

.3 Web server with network interface card to gather data from this system and generate web pages that can be accessed through conventional web browser on any PC connected to network,

.4 Operators to access this system through web browser, and browser interface to perform normal operator functions.

.2 Open protocol:

.1 Provide an integrated, open protocol building automation system, either/ or in combination: (a) BACnet to ANSI/ASHRAE Standard 135-2001,

.3 OEM Controller integration:

.1 provide hardware and software to allow bi-directional data communications between BAS and 3rd party manufacturers' control panels for;

(a) variable frequency drives.

.2 integrate real-time data from these systems.

.4 BAS network architecture - Dedicated LAN for BAS:

.1 BAS communication architecture to consist of at least two tiers with each tier using local area networks.

.2 Tier 1: Building Controller network;

(a) Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network communications. TCP/IP to be used as communication protocol on first tier network.

.3 Tier 2: Equipment Controller network;

(a) Lower level network providing communications between Equipment Control Units (ECU's) and BCU's.
(b) Open, peer-to-peer control networks to interconnect BAS controllers (Building Control Units, BCU's, and/or Equipment Control Units, ECU's) on ring or star topology bus.
(c) Peer-to-peer configuration means units exist and speak equally on same bus.
(d) Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.
(e) System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware
(f) Use of non-networked stand-alone control devices is not permitted.

2.4 General functional requirements

.1 Control mechanical and electrical equipment as specified in Control Sequences, shown on Control Schematics, detailed in Points Lists, and described in Equipment Schedules.

.2 System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware.

.3 Each controller;

.1 operates with local closed loop programming, independent from server, if peer-to-peer communication is interrupted;

.2 performs resident control routines;

(a) receiving information from field mounted sensors and switches and
(b) transmitting instructions to actuators to perform control sequences.

.3 manages local hardware and software alarms;

(a) to collect historical data,
(b) to facilitate operator input and output and
(c) to communicate with Central BAS web server and operator interface.

.4 Central BAS Web server;

.1 performs global application programs and data consolidation;

(a) communicating with controllers,
(b) obtaining data from field devices for central monitoring of building systems, and
(c) transmitting instructions to controllers.

.2 has software routines for;

(a) BAS Server operation,
(b) database creation and data storage,
(c) web based Graphical User Interface (GUI) with graphics generation and display, (d) report formulation, printing, and presentation,
(e) alarm detection and reporting and
(f) event initiated programming.

2.5 Performance

.1 General:

.1 information transmission and display times are based upon network, rather than modem, connections.

.2 test systems using manufacturer's recommended hardware and software for operator interface.

.2 Performance criteria:

.1 Graphic Display;

(a) display graphic with 20 dynamic points with current data within 10 seconds.

.2 Graphic Refresh;

(a) update graphic with 20 dynamic points with current data within 10 seconds and
(b) automatically refresh every 15 seconds.

.3 Configuration and Tuning Screens;

(a) special screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic to refresh every 5 seconds.

.4 Object Command response;

(a) time between command of binary object at Operator Interface (OI) and reaction by device to be less than 5 seconds.
(b) time between command of analog object at Operator Interface (OI) and start of adjustment to be less than 5 seconds.

.5 Alarm Response Time;

(a) time between when an object goes into alarm and when it is annunciated at Operator Interface (OI) to be less than 15 seconds.

.6 Program Execution Frequency;

(a) execution repeat frequency to be selected in manner consistent with mechanical process under control.
(b) custom and standard applications to be capable of executing as often as once every 5 seconds.
(c) programmable controllers to be able to perform PID control loop routines at selectable frequency, adjustable at Operator Interface (OI) down to once every second.
(d) workstations connected to network to receive alarms with not more than 5 seconds spread between first and last annunciation .

.7 Reporting Accuracy;

(a) system to report values with an end-to-end accuracy equal to or better than those listed below.
(b) control loops to maintain measured variable at set point value within tolerances equal to or better than those listed below.

2.6 Capacity for Future Expansion

.1 Tier 1 network;

.1 network backbone to have capacity for 10 routers or building controller/routers.

.2 each router or building controller/router on network backbone to have routing capacity for 10 controllers.

2.7 BAS Graphics

.1 BAS workstation to include graphic for each zone, mechanical system with links to navigate between floor plans graphic to indicate location of all BAS devices, power transformers, temperature/humidity/CO2/pressure sensors. Sequence of operation of every system to be linked to the graphics.

.2 At a minimum BAS graphics shall display the following:

.1 Facility Site Graphic

.2 Individual Graphics for each System

.3 Terminal Unit & Equipment Floor Plan

(a) Room Number and Area designation for each Terminal Unit & piece of Equipment

.4 A Main Page in Tabular Format displaying, as applicable, the following information for each piece of equipment/system

(a) Command Status
(b) State Status
(c) Current Set-Points
(d) Current Speed
(e) Current Temperatures
(f) Alarm Condition, if any, displayed in a different color.

.5 Alarms to be assigned a Priority Ranking and include Descriptor identifying relevant equipment and its location. (eg. E1 BLDG 040 P4 Condensate Pump failed to start <Room 008>

(a) Area served by Equipment/System with a link to the individual graphic for the said Equipment/System

.3 Graphics shall be developed using a standard library of image files and industry standard symbols.

.4 Graphics to have link to sequence of operation for the system in word/notepad format. PDF format to be stored on server for future reference.

3

4 EXECUTION

4.1 Examination

.1 Inspect site and thoroughly examine documents to establish locations for control devices and equipment and report discrepancies, conflicts, or omissions for resolution before starting rough-in work.

.2 Be responsible for correction of defects caused through neglect of inspections and examinations or failure to report and resolve discrepancies.

4.2 Existing equipment

.1 Reuse of control components:

.1 reuse existing equipment and components as listed below where condition and conformance with this specification permits;

(a) Valves and operators
(b) Dampers and operators
(c) Compressed air system
(d) Thermocouple wells
(e) Freezestats
(f) Firestats
(g) Limit, end, or level switches and air or liquid flow switches
(h) Static pressure sensors and controllers
(i) Wiring and conduit for safety controls and I/O points
(j) Relays
(k) Cabinets, and
(l) Other items specifically noted as existing, to be re-used.

.2 remove and replace existing temperature and humidity sensors with new units, throughout the installation,

.3 check and re-calibrate existing indicator gauges,

(a) under no circumstances are existing gauges or thermometers be removed.

.4 re-calibrate valves and dampers as part of installation of this system,

.5 existing wells for conventional control system may be reused for new sensors,

.6 pack temperature wells, both new and reused, with heat conductive grease.

.2 Condition survey:

.1 test, inspect and report on existing devices which are to be incorporated into the BAS, for

satisfactory operation within 30 days of award of contract and prior to installation of any new devices,

.2 for those items found in unacceptable condition, provide with report test data, original specification sheets or written functional requirements to confirm conclusion,

.3 Owner to arrange for repair or replacement of those existing items judged defective, but shown to be re-used in BAS and control system,

.4 items thus repaired or replaced by Owner will be returned to site and handed over to Contractor under this Section for storage, installation, testing, and commissioning.,

.5 warrant reused devices that have been rebuilt or repaired. Demonstrate satisfactory operating condition of reused devices at time of acceptance,

.6 responsibility for existing control devices that have been reused is to terminate at end of warranty period.

.3 Demolition and removals:

.1 Unless specifically noted or shown otherwise, remove existing control components made redundant:

(a) room thermostats, controllers, auxiliary electronic devices, pneumatic controllers and relays, control valves, electronic sensors, and transmitters, to be removed and placed in storage as directed by Owner.
(b) local control panels; removed and placed in storage as directed by Owner.

.2 remove and dispose of existing conduits, wiring and tubing in exposed areas as they become redundant,

.3 remove existing control compressed air systems and connect to new control air

system; (a) existing hardwired interlocks to remain installed in systems.

.4 in existing areas not otherwise involved in renovations, arrange and pay for holes and marks left by decommissioning and removal of control components, wiring, conduit, and tubing to be patched and refinished to match existing.

4.3 Existing System Operation.

.1 Mechanical systems to remain in operation and to maintain space conditions between hours of 6 a.m. and 9 p.m., Monday through Friday.

.2 In these periods mechanical control system shut downs of up to 15 minutes may be permitted, after obtaining written agreement from Owner.

.3 When time required for cut-over of controls will not meet these constraints, perform work outside of operating hours after making application; outlining areas affected; and likely length of interruption, and obtain written agreement from Owner.

.4 Maintain fan scheduling using existing or temporary time clocks or control systems throughout period of control system installation.

.5 Modify existing starter control circuits to incorporate hand-off-auto control of existing starters for motors to be controlled through BAS system.

4.4 Protection

.1 Protect work and material against damage during construction and be responsible for work and equipment until inspected, tested, and accepted.

.2 Protect material not immediately installed and close open ends with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

.3 Protect electronic equipment from elements during construction.

4.5 Coordination

.1 Coordinate and schedule control work with other work in same area to ensure orderly progress.

.2 Testing and balancing:

.1 Supply set of tools for Testing and Balancing Technicians to interface to control system, train these technicians in use of tools and provide qualified Control Technician to assist with testing and balancing first 10 terminal units.

.2 Tools to be turned over to Owners on completion of testing and balancing.

.3 Controls work by others:

.1 Integrate and coordinate this control work with controls and control devices provided or installed by others.

.2 Each supplier of control product to configure, program, start up, and test that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is specified or described.

.3 Resolve compatibility issues between control products provided under this section and those provided under other sections or divisions of this specification.

4.6 General Workmanship

.1 Installation to be performed by skilled and certified technicians.

.2 Install equipment, piping, and wiring or raceways horizontally, vertically, and parallel to building lines.

.3 Provide sufficient slack and flexibility in connections to allow for vibration isolation between conduit, raceways, piping and equipment.

.4 Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

.5 Install instrumentation and devices in locations providing adequate ambient conditions.

.6 Protect components placed in areas of potentially high humidity.

.7 All thermostats installed on perimeter wall shall be mounted on insulated backing.

4.7 Cleaning

.1 Clean up debris, remove packaging material, collect waste and place in designated location, on a daily basis.

.2 Keep work areas free from dust, dirt, and debris.

.3 On completion of work, check finish of equipment provided under this section for damage and repair damaged factory-finished paint, replace deformed cabinets and enclosures with new material, and repaint to match original.

4.8 Field Quality Control

.1 Ensure work, materials, and equipment comply with this specification and approved shop drawings.

.2 Monitor field installation for code compliance and workmanship quality.

.3 Arrange and pay for inspections by local or provincial authorities having jurisdiction.

4.9 Wiring

.1 Electrical materials, equipment and installation procedures under to conform to Ontario Electrical Safety Code as amended to date and standards established in Division 26.

.2 Conduit:

.1 thin wall (EMT) conduit up to and including 32mm (1/1/4 in) size for exposed wiring up to 3 m (10 ft) above floor level,

.2 rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40mm (1 ½ in) size and larger,

.3 watertight compression fittings in exterior locations.

.3 Run conduit and raceways parallel to building lines and be secured to building structure.

.4 Wiring not to be installed in conduit to be installed parallel to building lines and be secured to building structure with clips at minimum 3m (6 ft) centres. Where possible, wiring to run above corridors and in service spaces.

.5 Wiring in return air ceiling spaces to be plenum rated.

.6 Where conduit leaves heated areas and enters unheated areas, seal conduit.

.7 Provide interposing and motor control relays at local item of equipment or at associated MCC as applicable.

.8 Provide 120 VAC wiring as needed to support operation of system networking hardware, field panels, and controllers. Refer to Section 20 05 13 for description of division of work and responsibility.

.9 Provide control transformers for system components requiring power supply that do not have integral control transformers.

.10 Where point schematics and specifications indicate auxiliary contact provision, provide instrumentation, wiring, conduit, power supplies and services as to integrate these points into BAS.

.11 Mount transformers in enclosures

4.10 Identification of Equipment

.1 Identify discrete items of equipment with plastic nameplates, identifying equipment and function.

.2 Identification plates are in addition to manufacturers plates.

.3 Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment

is installed.

.4 Identification plates:

.1 provided for equipment identified with number designations in schedules and equipment shop drawings.

.2 marked with equipment type, number and service following wording and numbering used in contract documents and shop drawings

.3 laminated plastic

.4 white face and black centre

.5 minimum size 75 mm x 40 mm x 3 mm (3 in x 1½ in x c in),

.6 engraved with 6.5 mm (1/4 in) high lettering.

.7 securely attached to equipment.

.5 Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 50 mm (2 in) of termination.

.6 Permanently label or code each point of field terminal strips to show instrument or item served.

.7 Label each control component with permanent label. Label plug-in components so that label remains stationary during component replacement.

.8 Label room sensors related to terminal boxes or valves with nameplates. Place labels on back of sensors.

.9 Identify starters that are interfaced to BAS system with self-adhesive labels, white letters on red background as follows;

W AR N I N G

THIS EQUIPMENT IS OPERATING UNDER AUTOMATIC CONTROL AND MAY START OR STOP AT ANY TIME WITHOUT WARNING. SWITCH DISCONNECT TO "OFF"
POSITION BEFORE SERVICING.

.10 Submit samples of labels and nameplates for review prior to installation.

4.11 Acceptance

.1 After tests described in this specification are performed satisfactorily and checklists and reports are submitted and approved, certify acceptance of control system including:

.1 Control system checkout and testing

.2 Control system demonstration

.3 Training

.4 As-built documentation

.2 Certification document may identify tests that cannot be performed due to extenuating circumstances such as weather conditions. Append program to certification document for rectification and
completing these tests during warranty period.

4.12 Control System Checkout and Testing

.1 Provide schedule for start-up testing.

.2 Calibrate and prepare for service; equipment, instruments, controls, and accessories.

.3 Start-up testing to verify substantial completion of control system before system demonstrations begin.

.1 Verify that control wiring is connected and free of shorts and ground faults. Verify that terminations are tight.

.2 Enable control systems and verify input device calibration.

.3 Verify that binary output devices operate and that normal positions are correct.

.4 Check control valves and automatic dampers for proper action and closure and adjust valve stem and damper blade travel.

.5 Verify that analog output devices are functional, that start and span are correct, and that direction and normal positions are correct.

.6 Verify that system operates according to Sequences of Operation. Simulate changes in variables by overriding and varying inputs and schedules and observe and record each operational mode response.

.7 Tune PID loops and control routines.

.8 Check each alarm with an appropriate signal at value that will trip alarm.

.9 Trip interlocks using field contacts to check logic and to ensure that actuators fail in proper direction.

.10 Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

.4 Prepare and submit log documenting start-up testing of each input and output device and each control routine, with technician's initials certifying each device and each routine is functioning correctly and sensors have been calibrated. Include list of deficiencies, if any, and schedule setting out rectification program with time lines.

4.13 Control System Demonstration

.1 Obtain approval of start-up testing log and rectification program before scheduling demonstrations.

.2 Provide notification not less than 10 days before system demonstration begins.

.3 Demonstration to follow previously submitted and approved procedures;

.1 submit checklists and report forms for each system as part of demonstration,

.2 lists and forms to have initials of technicians conducting demonstrations,

.3 date of each demonstration and signatures of Owner’s representatives witnessing each demonstration section.

.4 Prior to acceptance, perform following tests to demonstrate system operation and compliance with specification after and in addition to tests specified above in Control System Checkout and Testing.

.5 Show field operation of;

.1 each Sequence of Operation.

.2 Operator Interface

.3 DDC loop response with graphical trend data output showing

(a) Each DDC loop response to set point change producing an actuator position change of at least 25% of full range.
(b) Trend sampling rate to be from 10 seconds to 3 minutes, depending on loop speed. (c) Loop trend data to show set point, actuator position, and controlled variable values.
(d) Documentation of further tuning of any loop that displays significantly under- or over-damped control

.4 Demand limiting routine with trend data output showing demand-limiting algorithm action;

(a) trend data to document action sampled each minute over at least 30-minute period and to show building kW, demand-limiting set point, and status of set-points and other affected equipment parameters.

.5 Building fire alarm system interface.

.6 Trend logs for each system point with;

(a) trend data to indicate set-points, operating points, valve positions, and other data as specified in points list provided with each Sequence of Operation,
(b) each log to cover three 48-hour periods and to have sample frequency not less than 10 minutes,
(c) show that Logs are accessible through operator interface and can be retrieved for use in other software programs.

.7 Substantiate calibration and response of any input and output points requested.

.8 Provide at least two technicians equipped with two-way communication.

.9 Provide and operate test equipment to establish calibration and prove system operation.

.6 Tests that fail to demonstrate system operation to be repeated after repairs and/or revisions to hardware or software is completed.

.7 Project record Submittals.

.1 Submit three copies of project record documents and obtain approval during acceptance procedures.

.2 Submit inspection certificates.

.3 Certificate of Acceptance to be withheld until Submittals are approved.

4.14 Training

.1 Materials:

.1 Provide course outline and materials for each class at least six weeks before first class.

.2 Provide training through instructor-led sessions, with computer-based, or web-based techniques.

.3 Instructors to be factory-trained and experienced in presenting this material.

.4 Perform classroom training using network of working controllers representative of installed hardware

.2 Operating staff training:

.1 Provide training for Owners operating staff using abovementioned training materials in self-paced mode, web-based or computer-based mode, classroom mode, or combination of these methods.

.2 Allow for 1 repeat sessions for each category to cover operator shift rotation.

.3 Training to enable students to accomplish following objectives.

.1 Group 1:

(a) Proficiently operate system
(b) Understand control system architecture and configuration
(c) Understand BAS system components
(d) Understand system operation, including BAS system control and optimizing routines (algorithms)
(e) Operate workstation and peripherals
(f) Log on and off system
(g) Access graphics, point reports, and logs
(h) Adjust and change system set-points, time schedules, and holiday schedules
(i) Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
(j) Understand system drawings and Operation and Maintenance manual
(k) Understand project layout and location of control components
(l) Access data from BAS controllers
(m) Operate portable operator's terminals

.2 Group 2:

(a) Create and change system graphics
(b) Create, delete, and modify alarms, including configuring alarm reactions
(c) Create, delete, and modify point trend logs (graphs) and multi-point trend graphs
(d) Configure and run reports
(e) Add, remove, and modify system's physical points
(f) Create, modify, and delete application programming
(g) Add operator interface stations
(h) Add new controller to system
(i) Download firmware and advanced applications programming to controller
(j) Configure and calibrate I/O points

.3 Group 3:

(a) Maintain software and prepare backups
(b) Interface with job-specific, third-party operator software
(c) Add new users and understand password security procedures

.4 Divide presentation of objectives into three sessions:

.1 Group 1: Day-to-day Operators.

.2 Group 2: Advanced Operators

.3 Group 3: System Managers and Administrator

.4 Participants will attend one or more of sessions, depending on knowledge and expertise level required.

.5 Provide each student with one copy of training material.

4.15 Submittals for Acceptance

.1 Provide system documentation at time of acceptance.

.2 As-built drawings;

.1 As-built interconnection wiring diagrams, or wire lists of field installed system with identified, ordering number of each system component and service.

.2 Floor plans with accurate depiction of location of system devices, controllers, and trunk wiring. Drawings to be constructed using Architectural backgrounds provided.

.3 Provide 2 copies on CD-ROM of above drawings in AutoCAD Release 2000 format without compression.

.4 Provide 5 full size hard copies of floor plan drawings.

.3 Operation and Maintenance (O&M) Manuals:

.1 Provide two paper copies of material and five copies on CD-ROM in Adobe PDF format.

.2 Describe operation, maintenance and servicing requirements of system and associated equipment.

.3 Provide following information in separate sections, each with an index.

(a) Service and parts;
- Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
- List of recommended spare parts with part numbers and suppliers.

(b) System description;
- English language outline of BAS system and system architecture
- As-built versions of shop drawing product data.
- Reduced size (11 in x 17 in) copies of record drawings
- Graphic files, programs, and database on magnetic or optical media.
- Licenses, guarantees, and warranty documents for equipment and systems.

(c) Technical literature for equipment, including;
- catalogue sheets,
- calibration, adjustments and operation instructions,
- installation instructions,
- hardware and software manuals, with information supplied by original product developer, on application programs and on computers and controllers supplied
- Operator's manual with procedures for operating control systems; logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set-points and variables.
- Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
- Original-issue documentation with installation and maintenance information for third-party hardware including computer equipment and sensors.
- Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- Programming manual or set of manuals with description of programming language and syntax, explanation of statements for algorithms and calculations used, procedures for point database creation and modification, documentation of techniques for program creation and modification, and instructions for use of editor.
- Documentation of programs created using custom programming language including set-points, tuning parameters, and object database. Electronic copies of programs to modify and create control logic, set-points, tuning parameters, and objects that can be viewed using programming tools.

.4 Original Software:

.1 Furnish one original set of application and system software on original media. Disks to bear manufacturer's label. Field copies are not acceptable.

.2 Original-issue copies of software to include operating systems, custom programming language, application generation, graphic support, maintenance support, operator workstation or web server software, and other utilities provided in support of installed system.

4.16 Correction After Completion

.1 After start-up, testing, and commissioning phase when satisfactory and reliable operation of equipment and systems has been demonstrated, acceptance to be certified. Guarantee period to begin on date established on certificate of acceptance.

.2 Provide (supply, install, de-bug and commission) updates and patches to resolve software deficiencies in operator workstation or web server software, project-specific software, graphic software, database software, and firmware during guarantee period.

.3 Provide (supply, install, de-bug and commission) upgrades that improve routines and procedures of operator workstation software, web server software, project-specific software, graphic software, or database software, free of charge, during guarantee period.

.4 Provide details of proposed changes and obtain written authorization before installation of updates, patches, or upgrades.

.5 Include preventative maintenance, with allowance for spare parts, labour, and emergency (24 hour) service for system and equipment during guarantee period.

.6 Equipment manufacturers to submit written undertakings to make circuit board repairs and provide spare parts, software support and patches, and technical assistance for at least five years after acceptance is certified.

END OF SECTION

B.A.S. BUILDING CONTROLLERS
25 13 01

1 GENERAL

1.1 Scope

.1 Provide Building Controllers (“BCU”) for Building Automation System.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

.1 Temperature - 0°C to 40°C (32°F to 104°F),

.2 Relative Humidity 10% to 90% non -condensing,

.3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal,

.4 Operating voltage: operate at 90% to 110% of nominal voltage rating and to perform an orderly shutdown below 80% nominal voltage,

.5 Operation to be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Building Controllers

.1 General:

.1 stand-alone, multi-tasking, multi-user, real time digital processors with hardware, software, and communications interfaces, power supplies, and input/output modular devices.

.2 removable (hot swappable) without disconnection of terminals and wiring,

.3 have access to data within network to accomplish global control strategies.

.4 support firmware upgrades without need to replace hardware and to have spare capacity for I/O.

.5 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

.6 monitor status of overrides and inform operator if automatic control has been inhibited, and allow operator to manually override automatic or centrally executed inhibit command.

.2 Input/ Output points:

.1 hardwired inputs and outputs to tie into system through various Building Control Units (BCU’s).

.2 protected such that shorting of point to itself, shorting of point to another point, or shorting of point to ground will not damage controller.

.3 protected such that voltage spikes of up to 24 V, of any duration, and any polarity will not damage controller.

.4 Analog input: compatible with, and field configurable to commonly available sensing devices using low voltage signals (0 -10 VDC), current signals (4 -20 ma), or resistance

signals from thermistors or RTD.

.5 Analog output: in form of modulating electronic signal, either voltage mode (0 -10VDC) or current mode (4 -20mA).

.6 Digital inputs: allow monitoring of on/off signals from remote devices. Digital inputs to provide wetting current of at least 12 ma and to be compatible with commonly available control devices.

.7 Digital outputs: provide on/off operation, or pulsed low voltage signal for pulse width modulation control. Digital outputs to be relays, 24 Volts AC or DC maximum, having 3 Amp maximum current. Each relay to be configured as normally open or normally closed, and either dry contact or bussed.

.8 Universal inputs: Thermistor Precon Type II, dry contacts, or 0 -5VDC with 0 -10K Ohm input impedance.

.3 Spare I/O capacity, each BCU:

.1 minimum of 15% spare I/O point capacity for each point type found at each location.

.2 15% of each type if input points are not universal,

.3 15% of each type if outputs are not universal,

.4 Minimum of one spare is for each type of point used.

.5 Future use of spare capacity to involve provision of field device, field wiring, point database definition, and custom software. These spare points to be configurable without additional controller boards or point modules. Wiring connections to be made to field-removable, through modular terminal strips or termination cards connected by ribbon cable.

.4 Time Clock:

.1 Controllers that perform scheduling operations to have on board real-time clock.

.5 Communications:

.1 communication port (RS-232 DB-9, RJ-11 or RJ-45) for connection to laptop computer or operator interface device to allow memory downloads and other commissioning and troubleshooting operations.

.2 communication services over BAS networks to support operator interface performance, and value passing as follows;

(a) connection of an operator interface device to any one controller on network to allow operator to interface with other controllers as if that interface were directly connected to those other controllers.
(b) data, status information, control algorithms, inputs, outputs, etc., from any controller on network is to be available for viewing and editing through operator interface device that is connected to any controller on network.
(c) links to execute control strategies to be programmed and tested so that an operator with appropriate password privileges is able to edit these links either by typing in standard object addresses, or by using simple point and click commands.
(d) daily routine automatically synchronize time clocks in controllers. An operator initiated change to master time clock setting to be automatically broadcast to other controllers on network.
(e) minimum baud rate for peer-to-peer communication between controllers in system LAN to be at 10 Mbps and communication with low level controllers, to be at 76 Kbps.

.6 GUI:

.1 face mounted LED type annunciation to display operational mode, and power and communication status.

.7 Tier 1 LAN:

.1 High level network providing communication between Building Control Unit's (BCU's) and workstations

.2 Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network communications. TCP/IP to be used as communication protocol on first tier network.

.3 Shall be designed with an expansion capacity of at 10 additional BCU/Routers over and above those required to complete the original installation.

.8 BACnet devices, Tier 1 network;

.1 Conformance Class 6,

.2 meet all the requirements for all of the lowered numbered classes as specified herein for Class 3, and

.3 in accordance with the requirements of ANSI BACnet 135-1995 for Classes 4 and 5, support the BACnet functional groups for;

(a) Clock,
(b) Time Master,
(c) Reinitialize,
(d) PCWS (Personal Computer Workstation),
(e) Event Initiation,
(f) Event Response and Files,

.4 support the standard BACnet object types of;

(a) Calendar,
(b) Command,
(c) Event Enrollment,
(d) File and Schedule, and
(e) support the Local_Time, Local-Date, UTC_Offset, Daylight_Savings_Status and Time_Synchronization_Recipient properties of the Device Object.

.9 Power interruption:

.1 In event of normal power loss;

(a) provide orderly shut down of controllers to prevent loss of database or software programming,
(b) incorporate non-volatile memory for critical configuration data,
(c) battery backup to be provided to support real time clock and volatile memory for minimum of 72 hours.

.10 Memory:

.1 sufficient memory to support operating system, program, and database requirements

including; (a) device and network management.
(b) data sharing.
(c) alarm and event management including custom alarm messages for each alarm level for each point noted in I/O Schedule.
(d) energy management.
(e) collection of historical trend data for operator selected points.
(f) maintenance support.
(g) scheduling.
(h) dial up communications.
(i) manual override monitoring.

2.3 Building Controller Software

.1 General

.1 System software to support alternate operating systems, such as Red Hat Linux, or Sun Solaris.

.2 Software to be completely web based without need for interface/translation devices or need to load software individually on each computer.

.3 System and software to be capable of remote access, for multiple users, through internet connections.

.4 Graphic files to be created with use of graphics generation package furnished with system.

.5 Applications software for building systems operation and monitoring and energy management to reside and operate in system controllers (BCU's).

.6 Using and editing of applications to be available to an operator with appropriate authorization, through operator workstation/browser interface or at other engineering workstations.

.7 Operator Interface designed to operate through standard desktop or laptop personal computers without requiring purchase of special software from BAS manufacturer.

(a) Interface on these personal computers to be standard Web Browser by Microsoft, Chrome or Firefox.

.8 System software to support automatic email notification

.9 Software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:

(a) BACnet
(b) MODBUS
(c) LONTalk
(d) OPC
(e) SNMP

.2 Software application programs:

.1 Scheduling

(a) capable of scheduling each object or group of objects,
(b) separate schedules for each day of week with up to five start/stop pairs. (10 events)
(c) exception schedules defined up to year in advance and once events on exception schedule day have been executed, definition of the exception schedule day will be discarded and replaced by standard schedule for that day of week.
(d) up to 24 holiday schedules may be placed on scheduling calendar and will be repeated each year.
(e) ability to override programmed start/stop based on outside temperature reaching or exceeding an adjustable value, operator initiated, individual for each system,
(f) temporary scheduler, ability to alter current schedule on a one time basis.

.2 Optimal Start/Stop

(a) Delay startup of each HVAC system to latest possible time which will allow building space to reach target conditions occupancy time
(b) Also advance shutdown of each system to earliest possible time.
(c) Include modeling techniques using building mass temperature and outdoor air temperature to predict building warm up and cool down times under different outdoor and indoor conditions.
(d) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.3 Temperature based load control

(a) Provide temperature setback or set up according to programmed occupancy schedules with capability to assign separate schedules to each control zone.
(b) Control of setback or set up achieved through setpoint adjustment, cycling of systems or cooling plant temperature conditions occupancy time
(c) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.4 Supply air reset

(a) Monitor heating and cooling loads in building spaces and adjust HVAC discharge sensors to most energy efficient levels which will still satisfy measured load zone.
(b) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.5 Enthalpy Economizer:

(a) Program to control outside and return and exhaust air dampers during the cooling season based on inside and outside enthalpy comparisons.
(b) modulate dampers to mix outside and return air for free cooling whenever outside temperature is less than the supply air temperature setpoint
(c) Use either return or outdoor air to effect smallest enthalpy change across the cooling coil whenever outside temperature is above the supply air setpoint.

.6 Grouping of objects

(a) able to group together objects associated with equipment based on function and location so that group may be used for scheduling, logging, assigning global commands and other applications.
(b) at a minimum, assemble the following groups
- each air handling unit and objects from all terminal units controllers associated with the specific air handling unit

(c) assemble other groups as directed by the Consultant, Commissioning Agent and Client

.7 Alarms

(a) each binary input and binary value object capable of generating an alarm based on an operator-specified state and to have capability to enable or disable this alarm.
(b) each analog object capable of generating an alarm based on an operator-specified high and low alarm limit and to have capability to enable or disable this alarm.
(c) delivered with alarms enabled as listed in Sequences of Operation.

.8 Electrical demand management

(a) capable of managing electrical demand by monitoring power consumption from signals received from pulse generator provided by others mounted at building power meter or from watt transducer or current transformers attached to building electrical feeder lines.
(b) If power consumption exceeds operator definable levels, system to be capable of automatically adjusting set-points, de-energizing low priority equipment, and taking other pre- programmed actions as described in Sequences of Operation to reduce demand.
(c) If demand drops below operator defined levels, action will be taken to restore loads in predetermined order.

.9 Maintenance Management.

(a) able to monitor equipment status and generate maintenance alarms based upon user- designated run-time, starts, or performance limits.
(b) configured to deliver maintenance alarms based upon Sequences of Operation.

.10 Sequencing.

(a) able to sequence chillers, boilers, and pumps with lead, lag, standby, priority assignment based upon run time,
(b) configured as specified in Sequences of Operation.

.11 PID Control.

(a) PID (proportional-integral-derivative) algorithm with direct or reverse action, controlled variable, set point, and PID gains user-selectable.
(b) this algorithm to calculate time-varying analog value that is used to position an output object or stage series of output objects.
(c) integral windup protection as a fundamental part of PID algorithm.

.12 Staggered Start.

(a) able to prevent controlled equipment from restarting simultaneously on power restoration after power outage.
(b) user-selectable sequence to establish order in which equipment (or groups of equipment) is started, and time delay between starts.

.13 Duty Cycling

(a) Periodically cycles run and stand-by equipment to equalize usage, on a calendar basis.

.14 Power Interruption Restart

(a) automatic system restart after a power failure,
(b) on resumption of power (normal or emergency transfer), command all equipment and devices to a de-energized state (system stop program).
(c) provide field verified time delay to permit all associated rotating equipment to come to a stop. (d) initiate restart of systems in accordance with current operating schedule requirements, and
Staggered Start program.

.15 Smoke Management

(a) Provide smoke management, smoke venting and pressurization control and communication integration with Fire Alarm System.

.16 Energy Calculations.

(a) calculation routines to establish and accumulate instantaneous power demand in kW, flow rates in L/s temperature differences in C° and convert information to energy usage data.
(b) two algorithms;
- first one calculates sliding window average with operator specified window intervals.
- second one calculates fixed-window average with digital input signal to define start of window period and synchronize fixed-window average calculation with start time used by utility.

.17 Anti-Short Cycling.

(a) routines to protect binary output objects from short cycling with operator selected on-time and off-time minimums.

.18 On/Off Control with Differential.

(a) direct-acting or reverse-acting algorithm that cycles binary output object based on operator selected controlled variable, set point and differential.

.19 Run-Time Totalization.

(a) calculation routine that totalizes run-times for any binary input or object with operator selected high runtime alarms.
(b) delivered with run time totalization and alarms configured as specified in Sequences of Operation.

3 EXECUTION

3.1 Equipment mounting

.1 Install equipment in accordance with manufacturer's recommendations.

.2 Mount units on modular channel frames (Unistrut or equivalent) adjacent to equipment being controlled.

.1 for free-standing frames, provide cross bracing and spread footing to withstand a horizontal seismic force equal to 150% of weight of BCU and support frame.

.2 BCU’s may be mounted directly to fixed building elements, including columns and walls.

.3 Do not mount or attach BCU or mounting frames to any equipment subject to vibration.

.3 Install piping securely anchored to structure or equipment.

.4 Make power connections to controller units and sensors.

3.2 Configuration

.1 Total number of devices on each Building LAN Bus not to exceed 80% of maximum device limitations .

END OF SECTION

B.A.S. EQUIPMENT CONTROLLERS 24 14 01

1 GENERAL

1.1 Scope

.1 Provide Equipment Controllers (“ECU”) for Building Automation System.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

.1 Temperature - 0°C to 40°C (32°F to 104°F)

.2 Relative Humidity 10% to 90% non -condensing

.3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal,

.4 Operating voltage: operate at 90% to 110% of nominal voltage rating and to perform an orderly shutdown below 80% nominal voltage,

.5 Operation to be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Equipment Controllers - General

.1 ECU’s separated into two types: Programmable, and Configurable.

.2 General:

.1 stand-alone, multi-tasking, multi-user, real time digital processors with hardware, software, and communications interfaces, power supplies, and input/output modular devices.

.2 removable (hot swappable) without disconnection of terminals and wiring,

.3 have access to data within network to accomplish global control strategies.

.4 support firmware upgrades without need to replace hardware and to have spare capacity for I/O.

.5 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

.6 monitor status of overrides and inform operator if automatic control has been inhibited, and allow operator to manually override automatic or centrally executed inhibit command.

.3 Input/Output points:

.1 hardwired inputs and outputs to tie into system through various Equipment Control Units (ECU’s).

.2 protected such that shorting of point to itself, shorting of point to another point, or shorting of point to ground will not damage controller.

.3 protected such that voltage spikes of up to 24 V, of any duration, and any polarity will not damage controller.

.4 Analog input: compatible with, and field configurable to commonly available sensing devices using low voltage signals (0 -10 VDC), current signals (4 -20 ma), or resistance signals from thermistors or RTD.

.5 Analog output: in form of modulating electronic signal, either voltage mode (0 -10VDC) or current mode (4 -20mA).

.6 Digital inputs: allow monitoring of on/off signals from remote devices. Digital inputs to provide wetting current of at least 12 ma and to be compatible with commonly available control devices.

.7 Digital outputs: provide on/off operation, or pulsed low voltage signal for pulse width modulation control. Digital outputs to be relays, 24 Volts AC or DC maximum, having 3 Amp maximum current. Each relay to be configured as normally open or normally closed, and either dry contact or bussed.

.8 Universal inputs: Thermistor Precon Type II, dry contacts, or 0 -5VDC with 0 -10K Ohm input impedance.

.4 Spare I/O capacity, each ECU:

.1 minimum of 15% spare I/O point capacity for each point type found at each location.

.2 15% of each type if input points are not universal,

.3 15% of each type if outputs are not universal,

.4 Minimum of one spare is for each type of point used.

.5 Future use of spare capacity to involve provision of field device, field wiring, point database definition, and custom software. These spare points to be configurable without additional controller boards or point modules. Wiring connections to be made to field-removable, through modular terminal strips or termination cards connected by ribbon cable.

.5 Time Clock:

.1 Controllers that perform scheduling operations to have on board real-time clock.

.2 In network application, time clock synced to associated BCU.

.6 Communications:

.1 communication port (RS-232 DB-9, RJ-11 or RJ-45) for connection to laptop computer or operator interface device to allow memory downloads and other commissioning and troubleshooting operations.

.2 communication services over BAS networks to support operator interface performance, and value passing as follows;

(a) connection of an operator interface device to any one controller on network to allow operator to interface with other controllers as if that interface were directly connected to those other controllers.
(b) data, status information, control algorithms, inputs, outputs, etc., from any controller on network is to be available for viewing and editing through operator interface device that is connected to any controller on network.
(c) links to execute control strategies to be programmed and tested so that an operator with appropriate password privileges is able to edit these links either by typing in standard object addresses, or by using simple point and click commands.
(d) daily routine automatically synchronize time clocks in controllers. An operator initiated change to master time clock setting to be automatically broadcast to other controllers on network.
(e) minimum baud rate for peer-to-peer communication between controllers in system LAN to be at 10 Mbps and communication with low level controllers, to be at 76 Kbps.

.7 Power interruption:

.1 continue to provide control functions in event of network communication failures.

.2 incorporate sufficient non-volatile memory to store critical configuration data in event of loss of normal power, and sufficient battery backup to support real time clock and volatile memory for minimum of 72 hours.

.8 Memory:

.1 sufficient memory to support its own operating system, including data sharing.

.9 GUI:

.1 face mounted LED type annunciation to display operational mode, and power and communication status.

.10 Tier 2 LAN:

.1 ECU's reside on either ARCNET or MS/TP physical data link layer protocol to provide BACnet internetworking, or reside on LonTalk FTT-10 network and provide data using LonMark standard network variable types and configuration properties.

.11 BACNet devices, Tier 2 Network;

.1 Conformance Class 3,

.2 support the BACnet functional groups for

(a) Change-of-Value (COV) Event Initiation,
(b) Change-of-Value (COV) Event Response,
(c) Event Initiation,
(d) Event Response,

.3 support the BACnet standard application services of;

(a) Read Property,
(b) Write Property.

.4 support the standard BACnet object types of;

(a) Device,
(b) Analog Input,
(c) Analog Output,
(d) Analog Value,
(e) Binary Input,
(f) Binary Output and Binary Value,
(g) Loop,
(h) Multi-State Input,
(i) Multi-State Output,
(j) Notification Class at a minimum.

.5 The described functionality provides reading and writing of all analog or digital inputs and outputs between BACnet devices on the network and provides for change-of-value initiation and reporting.

2.3 Equipment Control Unit (ECU) - Programmable

.1 General:

.1 capable of stand-alone, microprocessor-based operation.

.2 fully programmable controller for larger equipment and small systems such as hydronic air handling system, simple chiller or boiler plants, cooling towers and pumps.

.3 support firmware upgrades without need to replace hardware and to have minimum of 15 percent spare capacity of I/O functions.

(a) type of spares to be in same proportion as implemented functions on controller, but in no case there to be less than one point of each implemented I/O type.

.4 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

2.4 Equipment Control Units (ECU) - Configurable

.1 General:

.1 capable of stand-alone, microprocessor-based operation.

.2 purpose-built for specific application to which they are applied,

including; (a) terminal unit (VAV, CAV, FPVAV) box,
(b) unit heaters,
(c) fan coils,
(d) rooftop unit
(e) heat pumps
(f) local reheat zones
(g) perimeter heating control
(h) free-standing fans

.3 Optically isolated from other controllers on communication loop.

.4 Memory: maintain all BIOS and programming information in the event of a power loss for at least 90 days.

.2 Air terminal units (VAV, CAV and FPVAV boxes):

.1 integral damper electronic actuator on terminal unit controllers.

.2 auxiliary universal I/O points for control of reheat coil hot water control valve or SCR electric reheat coil, and a second zone (perimeter) heating control valve or SCR electric baseboard heater.

(a) 0-10 VDC, or 4-20 mA outputs

.3 factory calibrated velocity pressure sensor,

.4 calibration data stored in EEPROM memory for at least 15 velocity/pressure points within terminal unit range,

.5 terminal units ECU delivered to terminal unit manufacturer's factory for installation.

.3 Local zone control:

.1 wired to wall mounted temperature sensor with jack-style communications wiring.

2.5 Equipment Controller Software

.1 General:

.1 applications software for building systems operation and monitoring and energy management to reside and operate in system controllers (ECU's),

.2 using and editing of applications to be available to an operator with appropriate authorization, through operator workstation/browser interface or at other engineering workstations,

.3 software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:

(a) BACnet
(b) LonTalk
(c) MODBUS

.4 Memory resident and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic, and relational operators for implementation of control sequences.

.5 Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self learning).

.6 Adaptive Control algorithm used on control loops, as indicated in the I/O summary, where the controlled medium flow rate is variable (such as VAV units and variable flow pumping loops).

.7 Adaptive control algorithm monitor the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm operates in a continuous self learning manner and retains in memory a stored record of the system dynamics so that on system shutdown and restart, the learning process starts from where it left off and not from ground zero.

.8 Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

.9 Make available DDC setpoints, gains and time constants associated with DDC programs to the operator for display and modification via the central operator interface and portable operators terminal.

.10 Adjustable execution interval of each DDC loop from two to 120 seconds in one second increments.

.11 Assignment of initialization values to all outputs to assure that controlled devices assume a fail safe position on initial system start up.

.2 Configurable ECU programming:

.1 Series of user selectable and configurable pre-programmed control functions.

.2 Control parameters field adjustable during balancing to compensate for variations in terminal unit installation, type and size.

.3 Software application programs:

.1 Scheduling

(a) capable of scheduling each object or group of objects.
(b) separate schedules for each day of week with up to five start/stop pairs. (10 events)
(c) exception schedules defined up to year in advance and once events on exception schedule day have been executed, definition of the exception schedule day will be discarded and replaced by standard schedule for that day of week.
(d) up to 24 holiday schedules may be placed on scheduling calendar and will be repeated each year.
(e) ability to override programmed start/stop based on outside temperature reaching or exceeding an adjustable value, operator initiated, individual for each system

.2 Optimal Start/Stop

(a) Delay startup of each HVAC system to latest possible time which will allow building space to reach target conditions occupancy time
(b) Also advance shutdown of each system to earliest possible time.
(c) Include modeling techniques using building mass temperature and outdoor air temperature

to predict building warm up and cool down times under different outdoor and indoor conditions.

(d) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.3 Temperature based load control

(a) Provide temperature setback or set up according to programmed occupancy schedules with capability to assign separate schedules to each control zone.
(b) Control of setback or set up achieved through setpoint adjustment, cycling of systems or cooling plant temperature conditions occupancy time
(c) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.4 Supply air reset

(a) Monitor heating and cooling loads in building spaces and adjust HVAC discharge sensors to most energy efficient levels which will still satisfy measured load zone.
(b) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.5 Enthalpy Economizer:

(a) Program to control outside and return and exhaust air dampers during the cooling season based on inside and outside enthalpy comparisons.
(b) modulate dampers to mix outside and return air for free cooling whenever outside temperature is less than the supply air temperature setpoint
(c) Use either return or outdoor air to effect smallest enthalpy change across the cooling coil whenever outside temperature is above the supply air setpoint.

.6 Grouping of objects

(a) able to group together objects associated with equipment based on function and location so that group may be used for scheduling, logging, assigning global commands and other applications.
(b) at a minimum, assemble the following groups;
- each air handling unit and objects from all terminal units controllers associated with the specific air handling unit

(c) assemble other groups as directed by the Consultant, Commissioning Agent and Client

.7 Alarms

(a) each binary input and binary value object capable of generating an alarm based on an operator-specified state and to have capability to enable or disable this alarm.
(b) each analog object capable of generating an alarm based on an operator-specified high and low alarm limit and to have capability to enable or disable this alarm.
(c) delivered with alarms enabled as listed in Sequences of Operation.

.8 Electrical demand management

(a) capable of managing electrical demand by monitoring power consumption from signals received from pulse generator provided by others mounted at building power meter or from watt transducer or current transformers attached to building electrical feeder lines.
(b) If power consumption exceeds operator definable levels, system to be capable of automatically adjusting set-points, de-energizing low priority equipment, and taking other pre- programmed actions as described in Sequences of Operation to reduce demand.
(c) If demand drops below operator defined levels, action will be taken to restore loads in predetermined order.

.9 Maintenance Management.

(a) able to monitor equipment status and generate maintenance alarms based upon user- designated run-time, starts, or performance limits.
(b) configured to deliver maintenance alarms based upon Sequences of Operation.

.10 Sequencing.

(a) able to sequence chillers, boilers, and pumps with lead, lag, standby, priority assignment based upon run time,
(b) configured as specified in Sequences of Operation.

.11 PID Control.

(a) PID (proportional-integral-derivative) algorithm with direct or reverse action, controlled variable, set point, and PID gains user-selectable.
(b) this algorithm to calculate time-varying analog value that is used to position an output object or stage series of output objects.
(c) integral windup protection as a fundamental part of PID algorithm.

.12 Staggered Start.

(a) able to prevent controlled equipment from restarting simultaneously on power restoration after power outage.
(b) user-selectable sequence to establish order in which equipment (or groups of equipment) is started, and time delay between starts.

.13 Energy Calculations.

(a) calculation routines to establish and accumulate instantaneous power demand in kW, flow rates in L/s temperature differences in C° and convert information to energy usage data.
(b) two algorithms;
- first one calculates sliding window average with operator specified window intervals.
- second one calculates fixed-window average with digital input signal to define start of window period and synchronize fixed-window average calculation with start time used by utility.

.14 Anti-Short Cycling.

(a) routines to protect binary output objects from short cycling with operator selected on-time and off-time minimums.

.15 On/Off Control with Differential.

(a) direct-acting or reverse-acting algorithm that cycles binary output object based on operator selected controlled variable, set point and differential.

.16 Run-Time Totalization.

(a) calculation routine that totalizes run-times for any binary input or object with operator selected high runtime alarms.
(b) delivered with run time totalization and alarms configured as specified in Sequences of Operation.

3 EXECUTION

3.1 General

.1 Provide ECU's for control and instrumentation strategies as detailed in sequence of operation, and as shown.

.2 Provide custom programming to meet the control strategies as called for in the sequence of operation sections.

.3 Install equipment in accordance with manufacturer's recommendations.

.4 Mount units on modular channel frames (Unistrut or equivalent) adjacent to equipment being controlled.

.1 for free-standing frames, provide cross bracing and spread footing to withstand a horizontal seismic force equal to 150% of weight of ECU and support frame.

.2 ECU's may be mounted directly to fixed building elements, including columns and walls.

.3 Do not mount or attach ECU or mounting frames to any equipment subject to vibration.

.5 Install piping securely anchored to structure or equipment.

.6 Make power connections to controller units and sensors.

3.2 Tier 2 LAN device density

.1 Total number of devices on each Tier 2 LAN not to exceed 80% of maximum device limitations.

3.3 ECU database

.1 Configure each ECU and provide database to include:

.1 Terminal unit box type,

.2 Terminal unit box size,

.3 minimum and maximum air flows,

.4 reheat air flow: minimum turndown air flow prior to use of reheat,

.5 current air flow,

.6 calibration factor: for field calibration determines by air balancing,

.7 room temperature setpoint,

.8 maximum room temperature setpoint: occupant selectable,

.9 minimum room temperature setpoint: occupant selectable,

.10 cooling setpoint,

.11 heating setpoint,

.12 unoccupied cooling setpoint,

.13 unoccupied heating setpoint,

.14 afterhours maximum Timer: maximum time occupant may override unoccupied cycle,

.15 internal cooling Signal: used to reset supply air temperature if more cooling is required,

.16 internal Heating Signal: used to reset supply air temperature is less cooling is required

END OF SECTION

B.A.S. INSTRUMENTATION AND ACTUATORS
25 35 01

1 GENERAL

1.1 Scope

.1 Provide Instrumentation, dampers, control valves, and Actuators for Building Automation System.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

- .1 Temperature - 0°C to 40°C (32°F to 104°F)
- .2 Relative Humidity 10% to 90% non -condensing
- .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Power Supplies and Line Filtering

.1 Power Supplies:

- .1 control transformers to be UL listed,
- .2 line voltage units to be CSA listed,
- .3 provide over-current protection in primary and secondary circuits,
- .4 limit connected loads to 80% of rated capacity.

.2 D ; power supplies:

- .1 output to match equipment current and voltage requirements,
- .2 units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50%
- .3 units to have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure,
- .4 units to operate between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE
  0871 for Class B and MIL STD 810C for shock and vibration.

.3 Power Line Filtering:

- .1 provide internal or external transient voltage and surge suppression for workstations and control modules,
- .2 surge protection:
  - (a) dielectric strength of 1000 V minimum,
  - (b) response time of 10 nanoseconds or less,
  - (c) transverse mode noise attenuation of 65 dB or greater,
  - (d) common mode noise attenuation of 150 dB or greater at 40-100 Hz.

2.3 Motorized Control Dampers

.1 Construction:

.1 in accordance with section 23 33 14 - Dampers - Operating.

2.4 Electric/electronic actuators – air dampers

.1 Actuators for Air Handling Units dampers and general-purpose plenum/duct mounted dampers:

.1 electric/electronic type for two position or proportional operation as shown,

.2 enclosure:

(a) general purpose, drip proof enclosure for indoor applications,
(b) NEMA 4 enclosure for outdoor use and where dampers are exposed to the airstream inside an air intake plenum.

.3 gear type mechanism with spring-return to failed position as shown,

.4 mounted over damper shaft or with connecting linkage and with fastening clamp assembly,

.5 sized and selected in accordance with manufacturer's instructions,

.6 electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,

.7 angle of rotation adjustable between 0° to 90°,

.8 control signals:

(a) 0 - 10VDC or 0 - 20ma for proportional
control, (b) power On-Off for two position service,

.9 feedback signals:

(a) proportional service: 2 - 10 VDC position feedback signal.
(b) two position service: two SPDT auxiliary switches for end stop position indication.

.10 suitable for operation down to -35°C when installed outdoors.

.2 Actuators for dampers serving fuel-fired appliances and stationary engines – equipment and rooms:

.1 as above for general purpose duct mounted dampers and as follows.

.2 spring return to fail position on loss of power

supply: (a) combustion air dampers: fail-to-open
(b) ventilation inlet air dampers: fail-to-open
(c) recirculation air dampers: fail-to-close
(d) exhaust air dampers: fail-to-open.

.3 spring operating cycle time: <20 seconds at -20°C to 50°C (-4°F to 122°F)

.4 operating control:

(a) combustion air dampers: two position open/closed
(b) all other dampers: modulating with 0-10VDC or 4-20 mA input signal

Standard of Acceptance
- Belimo – EFB24-S N4/EFB120-S N4 series for two position dampers
- Belimo – EFB24-SR-S N4 series for modulating dampers

.3 Actuators for Terminal unit dampers:

.1 integrated DDC controller and damper actuator,

.2 sized and selected in accordance with terminal box damper manufacturer's specifications,

.3 gear drive, direct coupled type operators mounted to shaft with universal V-bolt clamp,

.4 proportional type control,

.5 selectable / reversible rotation direction,

.6 input type and range as suitable for interfacing to output of terminal unit controller,

.7 angle of rotation adjustable between 30 to 90° with mechanical limit stops,

.8 damper position indication visible without cover removal,

.9 manual override to set damper position without power applied to actuator,

.10 electronic stall protection,

.11 general purpose dust proof enclosure,

.12 actuator running time of not more than 100 seconds,

.13 delivered to terminal unit manufacturer's factory for installation.

2.5 Control Valves

.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; (a) line size,
(b) ball valves, sizes NPS 1 ½ and smaller,
(c) butterfly valves, sizes NPS 2 and larger.

.4 For two port and three port modulating service;

(a) use globe valves for CV rating 160 and smaller, (b) 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;

(a) straight through two port type, single seated, with replaceable disc or ball, (b) quick opening linear or equal percentage flow characteristics.

.2 modulating service;

(a) straight through two port type, single seated,
(b) equal percentage flow characteristics.

.3 modulating diverting service; three port mixing valves,

(a) linear for each port to give constant total flow or,
(b) 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;

(a) two-way modulating or two position service; 150% of pump shut off head.
(b) three-way modulating service; 300% of pressure differential between ports A and B at

design flow or 100% of pump shut off head.

(c) shut off head to be based on maximum rpm when pump is fitted with VFD

.5 sized as follows;

(a) for two-position service; line size.
(b) for two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;
- 200% of pressure drop through heat exchanger,
- 100% of pressure drop through coil,
- 50% of pressure difference between supply and return mains, or
- 35 kPa (5 psi).

(c) for three-way modulating service; pressure drop equal to smaller of;
- twice pressure drop through coil or heat exchanger, or
- 35 kPa (5 psi).

(d) for valves for radiation, terminal units and reheat coils;
- pressure drop of 7kPa (5 psig)

.6 failed position on isolation from control signal as follows;

(a) Heating water and glycol zone valves; normally open.
(b) Heating coil valves in AHU; normally open.
(c) Chilled water control valves; normally closed.
(d) Chilled water differential pressure by-pass control valves; normally open.
(e) Hot water and glycol differential pressure by-pass control valves; normally closed.

.3 Steam valves:

.1 globe type, with equal percentage flow characteristics.

.2 actuator and trim selected for close-off pressure rating equal to 150% of operating (inlet) pressure.

.3 sized as follows;

(a) two-position service;
- pressure drop at design flow equal to 10%-20% of inlet steam gauge pressure.

(b) modulating service at inlet steam gauge pressure of 100 kPa (15 psig) or less;
- pressure drop at design flow equal to 80% of inlet steam gauge pressure.

(c) modulating service at inlet steam gauge pressure of 101-350 kPa (16-50 psig);
- pressure drop at design flow equal to critical pressure drop (45% of absolute inlet pressure).

(d) modulating service with inlet steam gauge pressure over 350 kP(50 psig);
- pressure drop as scheduled.

(e) modulating steam loads greater than 570 kW (2000 lbs./hr) at all pressures;
- provide two valves, connected in parallel and controlled in sequence, with first valve in opening sequence sized for a and second for b of steam load.

2.6 Electric/electronic actuators - valves

.1 Valve actuators for service other than radiation, radiant panel and reheat coil valve applications:

.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:

(a) 0 to 10VDC or 0 to 20ma,
(b) modulate damper position with 2 to 10VDC or 4 to 20ma input signal operating range when in proportional service.
(c) input type and range as suitable for interfacing to output of BAS controller

.10 feedback signals:

(a) 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.

.2 Valve actuators for service on radiation, radiant panel, and reheat coil valve applications:

.1 output shaft driven by gear train mechanism.

.2 reversible motor with automatic load limit,

.3 input type and range as suitable for interfacing to output of BAS controllers,

.4 adjustable span and offset travel,

.5 position feedback signal on actuators used for proportional control,

.6 general purpose, dustproof, die-cast aluminum housing,

.7 actuator rotation limit.

2.7 Temperature switches

.1 Low temperature limit thermostat (freezestat):

.1 6m (20 ft) of sensing capillary sensitive to freezing air over any 400mm (15 in) section,

.2 manual reset switch

.3 installed in multiples with one unit serving not more than 5 m^2 (40 sq ft) of duct area.

.4 single pole double throw (SPDT) contacts where used as digital input to BAS

.5 1.7°C to 7.2°C (35°F to 45°F) operating temperature range

.6 adjustable set point within specified range

.7 protective enclosure.

.2 Temperature switches:

.1 sensing element of liquid, vapour or bimetallic type,

.2 adjustable set-point and differential of at least 0.22°C to 1.7°C (0.4°F to 3.0°F),

.3 snap action type rated at 120 volts, 15 amps or 24 volts DC,

.4 automatic in operation and automatically reset when condition returns to normal.

.5 suitable for wall mounting on standard electrical box with protective guard, or suitable for insertion into air ducts with insertion length of 450 mm (18 in), or

.6 thermowell type with compression fitting for 20 mm (0.8 in) NPT well, mounting length of 100 mm (4 in), and immersion wells of type 316 stainless steel, or

.7 Strap-on-type with helical screw stainless steel clamps.

.8 23°C to 57°C (75°F to 138°F) operating temperature range

.9 adjustable set point within specified range

.10 single pole double throw (SPDT) contacts where used as digital input to BAS

.11 protective enclosure.

2.8 Temperature sensors/transmitters

.1 Sensor alternative technologies:

.1 Resistance temperature device (RTD) of precision thin film platinum element

type; (a) linear characteristics over sensor range,
(b) 1000 ohm, ±20 ohms (2%) reference resistance at 0°C (32°F),
(c) 0/.0385ohms/ohm/°C (0.0212 ohms/ohm/°F) temperature coefficient of resistance and
(d) ±0.36°C at 21°C (±0.65°F at 70°F) accuracy

.2 Resistance temperature device (RTD) of precision thin film nickel element type, with

(a) linear characteristics over sensor range,
(b) 1000 ohm, ±20 ohms (2%) reference resistance at 21°C (70°F),
(c) 5.4 ohm/°C (3.0 ohm/°F) temperature coefficient of resistance and
(d) ±0.18°C at 21°C (±0.34°F at 70°F) accuracy

.3 Thermistor with

(a) non-linear negative temperature coefficient of resistance,
(b) 10,000 ohms reference resistance at 25°C (77°F),
(c) curve matched to±0.2°C (±0.36°F) temperature accuracy over 0°C to 70°C (32°F to 158°F), and
(d) long term stability of 0.025°C (0.045°F) drift per year

.2 Each sensor:

.1 2 integral anchored lead wires

.2 waterproof sensor to sheath seal

.3 strain minimizing construction

.4 standard conduit box termination with cover

.5 pig-tail wire leads with wire nuts or screwed terminal connector block

.6 factory calibrated and capable of end to end (sensing element to BAS) accuracy of±0.25°C (±0.5°F) over full range of measured variable.

.7 transducing circuit to convert output to signal compatible with equipment controller

.8 concealed USB or serial communications port for portable PC or hand-held commissioning equipment.

.3 Averaging element type temperature sensors:

.1 average style element for ducts of greater cross section than 0.4 m^2 (4 sq ft).

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 copper sheathed construction

.4 non-condensing 5 to 95% RH

.5 minimum immersion length of 4000 mm (13 feet)

.6 probe field formable to minimum radius of 100mm (4 in) at any point along probe length, other than with 200 mm (8 in) of connector box, without degradation of specified performance

.7 provided as multiple sensors where single averaging element cannot be located to provide proper duct or plenum temperature sampling.

.4 Duct mount probe type temperature sensors:

.1 provided for ducts of cross section less than 0.4 m^2 (4 sq ft)

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 copper or brass or stainless-steel sheathed construction

.4 non-condensing 5 to 95% RH

.5 metal mounting plate

.6 length such that sensing element is no less than a of duct width or diameter from duct wall greater

.7 provided as multiple sensors where single element cannot be located to provide proper duct or plenum temperature sampling.

.5 Thermowell mount type temperature sensors:

.1 insertion elements for measurement of fluid temperatures with stainless steel sheath

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 spring loaded construction with compression fitting for 20mm (NPS ¾) well mounting

.4 length suitable for application

.5 stainless steel or chrome plated brass thermowells of size and material to suit relevant sensor, pipe and service

.6 Outside air temperature sensors:

.1 insertion type for through-the-wall installation with stainless steel sheath

.2 sensor operating temperature range from –25°C to 60°C (-13°F to 140°F)

.3 waterproof seal at wall

.4 non-condensing 5 to 95% RH

.5 total active probe length of 100 mm to 150 mm (4 in to 6 in)

.6 with non-corroding outdoor shield to minimize solar heating effect and

.7 inert section passing through wall to allow precise measurement of outdoor temperature.

.7 Space temperature sensors with display:

.1 for measurement and adjustment of space temperatures in rooms at designated location as shown on plans or described in Sequences of Operation.

.2 digital key pad or slider control for temperature adjustment, 20°C to 25°C (68°F to 78°F)

.3 On/Off button to allow occupant override feature.

.4 three-digit LED digital temperature display with 0.2° display resolution

.5 5 to 95% RH non-condensing

.6 set point operating temperature range from 4°C to 60°C (40°F to 140°F)

.7 minimum/maximum limit set point values adjustable from BAS operator interface and controller

.8 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors.

.9 guard secured to mounting plate by screws.

.8 Space temperature sensors - Secure Areas:

.1 for measurement of space temperatures at locations subject to vandalism as shown on plans or described in Sequences of Operation.

.2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F)

.3 stainless steel flat plate surface type with sensor epoxy-bonded to back of cover plate.

.4 tamperproof / secure concealed fasteners.

2.9 Humidity sensors - electronic

.1 Each humidity sensor:

.1 suitable for operating ranges of 10 to 100% R.H.

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 solid state sensing element,

.4 accuracy of ± 3% over range of 5 to 95% R.H.

.5 independent, non-interactive span and zero adjustments

.6 0-100% linear proportional output signal indicating relative humidity, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.7 strain minimizing construction

.8 dust proof enclosure

.9 screwed terminal connector block.

.2 Duct mount probe type humidity sensors:

.1 metal mounting plate

.2 constructed with 304 stainless steel element enclosure

.3 length such that sensing element is not less than a of duct width or diameter from duct wall.

.3 Outside air type humidity sensors:

.1 weatherproof enclosure with cover

.2 waterproof seal.

.4 Space humidity sensors:

.1 surface mounted plastic guard with surface mounting plate and wall anchors

.2 guard secured to mounting plate by screws

.3 analogue LCD humidity display.

2.10 Duct type combination temperature and humidity sensors

.1 Where both temperature and humidity are shown to be measured at same location or in same airstream, use of single measuring unit is permitted provided that features and performance of both temperature sensor and humidity sensor are in accordance with requirements of this specification.

2.11 Pressure sensors/transmitters and pressure switches

.1 General:

.1 Rating of chilled and condenser water units: 1000 kPa (125 psi).

.2 Rating of hot water units: 1000 kPa (125 psi).

.3 Rating of steam units: 1200 kPa (150 psi).

.4 Rating of high temperature water units: 2700 kPa (400 psi)

.5 Pressure sensors monitoring fan operation to have set point adjustable from 0 to 3600 Pa (0 to 10 in wg.) and adjustable differential between 10 to 300 Pa (0.03 to 1 in wg).

.2 Static pressure and differential pressure sensors for air or inert gas - electronic:

.1 diaphragm driven, capacitance change type, 0-100% linear proportional output signal indicating static pressure or differential pressure at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.2 field adjustable zero and span

.3 selected with span of not greater than twice maximum static pressure and not less than twice differential pressure at shut-off.

.4 accuracy, including non-linearity, hysteresis and non-repeatability; ±1% full scale

.5 operating temperature range; -18°C to 80°C (0°F to 175°F)

.6 operating humidity range; 10 to 90% non-condensing

.7 high- and low-pressure ports, brass hose barbed pressure fittings suitable for 8 mm (¼ in) tubing

.8 mounting bracket, suitable for duct mounting

.9 dust proof enclosure, and

.10 screw terminal connector block.

.3 Pressure transducers - electronic:

.1 suitable for use in water, glycol, steam, ammonia and non-corrosive refrigerants,

.2 series 300 stainless steel construction, stainless steel diaphragm

.3 sealed electronics

.4 0-100% linear proportional output signal indicating pressure at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.5 designed for 3 times rated range over pressure without damage

.6 low pressure range 1 to 700 kPa (0 to 100 psig)

.7 high pressure range 1 to 3400 kPa (0 to 500 psig)

.8 accuracy including non-linearity, hysteresis, and non-repeatability; ±1% full range span

.9 operating temperature range; -40°C to 100°C (-40°F to 212°F)

.10 operating humidity range; 10 to 90% non-condensing

.11 suitable for direct mounting to pressure port

.12 dust proof enclosure, and

.13 screw terminal connector block.

.4 Differential pressure transmitters for terminal units:

.1 suitable for use in air with pressure independent terminal units (constant volume, variable volume or fan powered)

.2 capacitive sensor technology

.3 pressure range 0 Pa to 373 Pa (0 to 15 in.w.g.)

.4 linear output proportional to velocity pressure of unit inlet air stream, and suitable as analog input to terminal unit controller

.5 accuracy including non-linearity, hysteresis, and non-repeatability; ±1% full scale

.6 operating temperature range; 0°C to 50°C (32°F to 122°F)

.7 operating humidity range; 10 to 90%non-condensing

.8 high and low pressure ports, barbed pressure fittings suitable for 8 mm (¼ in) tubing for connection to air flow pick up device provided with terminal box

.9 mounting kit, suitable for installation within terminal unit controller enclosure

.10 coded screw terminals

.5 Differential pressure switches:

.1 spring loaded diaphragm type

.2 suitable for use with air or inert gas,

.3 adjustable set-point and differential,

.4 snap acting SPDT contacts suitable for use as digital input to BAS

.5 switch mounted with diaphragm in vertical plane

.6 automatic in operation and automatically reset when condition returns to normal.

.7 operating temperature range; 0°C to 60°C (35°F to 140°F)

.8 operating humidity; 10 to 90% RH non-condensing

.9 high and low pressure ports, brass hose barbed pressure fittings suitable for 8 mm (¼ in) tubing

.10 mounting bracket suitable for duct mounting,

.11 dust proof enclosure, and

.12 screw terminal block

2.12 Gas analysis sensors

.1 Carbon dioxide (CO_2) sensors:

.1 range: 0 to 2000 ppm CO_2 in air

.2 dual element, non-dispersive, thermally compensated lithium tantalate infrared detector

.3 SPST relay with field adjustable trip point and adjustable time delay for alarm indication at BAS,

.4 LCD display of ppm level, trip set point and time delay

.5 LED’s indicating normal operation and alarm

.6 output signal suitable as analog input indicating gas concentration at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.7 accuracy; ±3% full scale

.8 drift; less than ±2% full scale

.9 repeatability; ±1.0% of full scale

.10 maximum one hour warm up time

.11 6 seconds maximum response time

.12 operating temperature range; 0°C to 50°C (32°F to 122°F)

.13 operating humidity range; 0 to 95% RH

.2 Carbon monoxide (CO) sensors:

.1 range: 0 to 250 ppm CO in air

.2 solid state type

.3 DPDT relay with field adjustable trip point for local audible and visual alarm and remote annunciation at BAS,

.4 LCD display of ppm level, alarm trip set point

.5 LED's indicating normal operation and alarm

.6 audible alarm 65dBA at 1 meter (3 feet) and visual alarm

.7 output signal suitable as analog input indicating gas concentration at station, 4-20 mA, 0-5 Vdc or 0 - 10 Vdc

.8 accuracy; ±5% full scale

.9 operating temperature range; -10°C to 40°C (19°F to 105°F)

.10 operating humidity range; 0 to 95% RH

2.13 Air flow switches

.1 General:

.1 for indication of air flow within duct.

.2 differential pressure activated, diaphragm type, snap acting SPDT switch rated at 9.8 amp 120/1/60 AC full load.

.3 stainless steel flow paddle of suitable length and width for duct area and air flow

.4 snap-action SPDT switch

.5 field adjustable set point

.6 maximum air velocity; 10.2 m/s (2000 fpm)

.7 switch mounted with paddle shaft in horizontal position

.8 operating ambient temperature range; 0°C to 40°C (32°F to 104°F)

.9 dustproof enclosure with mounting plate and gasket seal.

2.14 Liquid flow switches

.1 General:

.1 for indication of fluid flow in piping systems.

.2 suitable for use with water, ethylene or propylene glycol, chlorinated or treated water

.3 snap-action SPDT switch

.4 operating ambient temperature range; 0°C to 82°C (32°F to 180°F)

.5 operating liquid temperature range: 0°C to 121°C (32°F to 250°F)

.6 general purpose dust proof enclosure for use indoors with fluids at temperature greater than 0°C (32°F)

.7 NEMA 3R vapour tight enclosure for use indoors or outdoors with fluids at temperatures below 0°C (32°F).

2.15 Electrical devices

.1 Current sensing relays:

.1 metering transformer ranged to match load being metered,

.2 plug in base and shorting shunt to protect current transformer when relay is removed from socket,

.3 current transformer for single or three phase metering connected into single relay,

.4 adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level,

.5 discrimination between phases in three phase applications to allow worst case selection,

.6 mounted in motor starter enclosure and fed from starter control transformer,

.7 relay contacts capable of handling 10 amps at 240 volts.

.2 Current transducer:

.1 output signal proportional to measured line current,

.2 output signal in one of following ranges; 4-20 mA, 0-5 Vdc or 0-10 Vdc

.3 Control Relays:

.1 plug-in type, UL listed, with dust cover and LED "energized" indicator.

.2 contact rating, configuration, and coil voltage suitable for application.

.3 NEMA 1 enclosure for relays not installed in local control panels.

.4 Time Delay Relays:

.1 solid-state plug-in type, UL listed, with adjustable time delay adjustable ±100% from set point shown.

.2 contact rating, configuration, and coil voltage suitable for application.

.3 NEMA 1 enclosure for relays not installed in local control panels.

.5 Override Timers:

.1 spring-wound line voltage, UL Listed, with contact rating and configuration by application unless implemented in control software.

.2 0-6 hour calibrated dial.

.3 flush mounted on local control panel face.

.6 AC Current Transmitters:

.1 self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output.

.2 full-scale unit ranges of 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment.

.3 ±1% full-scale accuracy at 500 ohm maximum burden.

.4 UL/CSA listed and meet or exceed ANSI/ISSA 50.1 requirements.

.7 AC Current Transformers:

.1 UL/CSA listed

.2 completely encased (except for terminals) in approved plastic material.

.3 selected for appropriate current ratios with ±1% accuracy at full-scale output.

.4 fixed-core transformers for new wiring installation

.8 AC Voltage Transmitters:

.1 self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

.2 adjustable full-scale unit ranges; 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac.

.3 ±1% full-scale accuracy at 500 ohm maximum burden.

.4 UL/CSA listed, 600 Vac rated and conforming to ANSI/ISSA 50.1.

.9 AC Voltage Transformers:

.1 UL/CSA listed, 600 Vac rated with built-in fuse protection.

.2 suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and

.3 ±0.5% accuracy at 24 Vac and 5 Vac load.

.4 windings (except for terminals) enclosed with metal or plastic.

.10 Power Monitors:

.1 three-phase type with three-phase disconnect and shorting switch assembly,

.2 UL listed voltage transformers, and

.3 UL listed split-core current transformers.

.4 selectable output either rate pulse for kWh reading or 4-20 mA for kW reading.

.5 maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

.11 Current Switches:

.1 self-powered, solid-state type with adjustable trip current

.2 integral current transformers and relays to indicate motor status

.3 SPDT output relay suitable for use as digital input

.4 field adjustable output relay trip setting, over 0-100% of range. Deadband adjustment to maximum of 10% of range

.5 integral zero-leakage LED’s indicating sensor power and switch status

.6 long term setting drift of current transformer and relay combination not more than 5% full range over 6 months

.7 over current and over voltage protection for current transformer and relay

.8 operating temperature range; -10°C to 50°C (14°F to 122°F)

.9 operating humidity range; 5% to 90% RH non condensing

.12 Electronic signal isolation transducers:

.1 provided whenever;

(a) an analog output signal from BAS is connected to an external control system as an input (such as chiller control panel) or

(b) BAS is to receive an analog input signal from an external remote system.

.2 designed for ground plane isolation between systems.

2.16 Local equipment panels

.1 General:

.1 NEMA 2 sheet metal cubicles with vertically hinged lockable doors,

.2 sensors, transducers, BAS controllers, and relays mounted on backing board and/or DIN rails within inner section,

.3 enclosures sized to house controllers and associated transformers, control relays, wiring, conduits and other auxiliary equipment.

.4 engraved lamacoid labels with white lettering indicating function of each sensor, transducer, controller, gauge and instrument.

.5 wiring terminations labelled

.6 EMT conduit openings and adapters in sufficient quantities and sizes to accommodate wiring terminating within enclosure

.7 wiring within enclosure installed in neat and protected manner, enclosed in wireways or plastic conduit.

.8 inside each panel, one set of as built, plasticized control Shop Drawings for equipment served by that panel permanently affixed to cabinet frame.

2.17 Wiring and Raceways

.1 Wiring, conduit, and raceways to Section 20 05 13.

.2 Wire used for power and control:

.1 insulated copper conductors,

.2 UL listed for minimum 90°C (200°F) service.

.3 Power wiring minimum 12 gauge.

.4 Control wiring for digital functions: 18 AWG minimum with 300 Volt insulation.

.5 Control wiring for analog functions: 18 AWG minimum with 300 Volt insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.6 Transformer current wiring: 16 AWG minimum.

.7 Sensor wiring: 22 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware. Provide additional conductors as to support supplemental features of sensor (i.e. set- point adjustment, override, etc.)

3 EXECUTION

3.1 Installation of Sensors

.1 General:

.1 Mount sensor assemblies and elements;

(a) in clean areas wherever possible,
(b) accessible to allow for replacement and servicing without interfering with access for adjacent equipment and personnel traffic in surrounding space,
(c) provide access doors where assemblies and elements are concealed.

.2 Install transmitters, transducers, controllers, solenoid air valves and relays in NEMA2 enclosures;

(a) install wiring and tubing within enclosures in trays or individually clipped to back of panel with identification tags and terminal numbers visible.

.3 Rigidly support field mounted transmitters, transducers, and sensors on pipe stands or channel brackets.

.4 Orient sensing elements to correctly sense measured variable and to be isolated from vibrations and environmental conditions that could affect measurement or calibration.

.5 Identify each cable and wire at every termination point.

.6 Air seal wires attached to sensors at entry into junction box.

.2 Temperature sensors:

.1 Install room temperature sensors on concealed junction boxes supported by wall framing.

.2 Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in serpentine manner vertically across duct. Support each bend with capillary clip.

.3 Install mixing plenum low-limit sensors in serpentine manner horizontally across duct. Support each bend with capillary clip. Provide sensor element length to coil area ratio of 3 m per 1 m^2 (1 ft per 1 sq ft).

.4 Install pipe-mounted liquid temperature sensors in wells with heat-conducting material. Where thermowell installation necessitates shutting down of pumps or draining of pumps, coordinate with Consultant and Owner.

.5 Cut and recover piping insulation to one foot either way for installation of strap-on temperature sensors. Provide removable insulation box over sensor and patch insulation to match existing.

.6 Install outdoor air temperature sensors on north facing wall with sun shield.

.7 Mount space temperature and humidity sensors 1200 mm (4 ft) above finished floor.

.3 Pressure sensors:

.1 Mount gauge tees adjacent to water differential pressure taps. Install shut-off valves before tee for water gauges.

.4 Differential air static pressure sensor installations:

.1 Supply duct static pressure;

(a) pipe high-pressure tap to duct using pitot tube,
(b) make pressure tap connections according to manufacturer's recommendations.

.2 Return duct static pressure;

(a) pipe high-pressure tap to duct using pitot tube,
(b) make pressure tap connections according to manufacturer's recommendations.

.3 Building static pressure;

(a) pipe pressure sensor's low-pressure port to static pressure port located on outside of building through high-volume accumulator,
(b) pipe high-pressure port to location behind thermostat cover.

.4 Piping to air pressure transducer pressure taps to contain capped test port adjacent to transducer.

.5 Locate air pressure transducers, except those controlling terminal unit

boxes; (a) in control panels, not on monitored equipment or on ductwork,
(b) mount transducers in vibration-free location accessible for service without use of ladders or special equipment.

.5 Airflow measuring stations:

.1 Provide transducers, relays, and interconnection wiring to perform Sequences of Operations as detailed and Monitoring in accordance with Controls Schematics.

.6 Fluid pressure measuring stations:

.1 Isolation valve and snubber to be installed between pressure sensor and pressure source.

.2 Sensors and switches on steam lines and high temperature water to be protected by pigtail siphon installed between sensor and fluid line.

.3 provide two pressure transducers with software calculation at controller for differential pressure measurements in fluid piping systems.

.7 Safety controls:

.1 Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches and controls to be hard-wired to de-energize equipment as described in Sequence of Operation.

(a) unless otherwise shown.

.2 Safety switches and controls to require Operator intervention to activate local manual reset.

.3 Provide contacts that allow BAS software to monitor safety control status.

.8 Flow Switch Installation

.1 Fit correct length paddle for diameter of pipe.

.2 Adjust switch for specified flow condition in accordance with manufacturer's instructions

3.2 Actuators

.1 General:

.1 Mount actuators and adapters according to manufacturer's recommendations.

.2 Electric and Electronic Damper Actuators:

.1 Mount damper actuators directly on damper shaft or jackshaft

.2 Mount valve actuator directly on shaft or with linkages according to manufacturer's recommendations.

.3 For low-leakage dampers with seals, mount actuator with minimum 5° travel available for damper seal tightening.

.4 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close damper, then tighten linkage.

.5 Provide mounting hardware and linkages for actuator installation.

.3 Valve Actuators:

.1 Connect actuators to valves with adapters approved by actuator manufacturer.

END OF SECTION

B.A.S. SEQUENCE OF OPERATIONS
25 90 01

1 GENERAL

1.1 Definitions

.1 System Start: actions required at system start-up under schedule control or on re-start after power failure.

.2 Normal Operation: normal control sequence after initial start-up requirements are satisfied.

.3 Demand Limiting: special operation parameters during normal utility power outages (emergency generator operation)

.4 System Stop: shut-down of system under schedule control and fail-safe position of system in event of loss of normal power.

.5 Fire Alarm: action required in the event of a signal from the fire alarm system (FA).

.6 Schedule: scheduled operation of system

.7 Alarm: minimum alarm points required.

.8 Emergency Power: control system elements to be fed from emergency power, refer to electrical drawings.

2 PRODUCTS

2.1 Refer to Sections of Division 25 00 00 BUILDING AUTOMATION SYSTEM

3 EXECUTION

3.1 Sequence of operation and control drawings

.1 Control sequences that follow describe and detail suggested method of control of systems.

.2 Control drawings listed for each control sequence illustrate required inputs and outputs for the control and monitoring of systems.

.3 Review sequence of operation described for each system and allow for additional input and output points to achieve method of control described. Review documents to determine quantity of each piece of equipment or system.

.4 Sequences of Operation

.1 CS 101 VAV Box Controls

.2 **CS** 102 Fan Powered Box Controls

CS101 – VAV Box with Reheat Controls

Applicable System: VAV and Fan Powered Boxes

Sequence:

1. The system is monitored and controlled by the Building Automation System (BAS).

2. System Control:
   2.1. Schedule:
      2.1.1. The system operates via pre-programmed occupancy time schedule. Coordinate final occupancy schedule with Owner.
   2.2. Manual Override:
      2.2.1. Override On:
         2.2.1.1. The operator's command on BAS shall override the time schedule and optimum start and stop control and revert the system into normal or low occupied mode.
      2.2.2. Override Off:
         2.2.2.1. The operator's command on BAS shall override the time schedule and optimum start and stop control and revert the system into unoccupied mode.

3. Fan Powered Box
   3.1. The FPVAV series type with reheat fan shall run continuously during occupied periods. The FPVAV terminal box controller monitors the space temperature sensor and velocity sensor. The controller shall modulate the cold supply air damper and modulate the reheat valve to maintain the desired room temperature. If the space temperature is below its adjustable setpoint, the primary air damper shall modulate to its minimum position. On further drop in space temperature below the setpoint, reheat valve shall modulate open to maintain space temperature. As the space temperature rises above its setpoint, the reheat valve shall be closed and the primary air damper shall modulate open to maintain space temperature setpoint.
   3.2. The supply air volume shall be constant and primary air will be limited by its minimum and maximum supply air volume settings.
   3.3. When the air handling system is in warm-up mode, the primary air damper and the reheat shall have full output.
   3.4. All FPVAV terminal units shall be addressable from the standalone controllers.
   3.5. During unoccupied periods, FPVAV shall act as unit heaters to maintain unoccupied heating setpoint. Fan shall be enabled and reheat shall have full heating capabilities.

4. VAV Box
   4.1. The VAV terminal box controller monitors the space temperature sensor and velocity sensor. The controller shall modulate the cold supply air damper to maintain the desired room temperature. If the space temperature is below its adjustable setpoint, the primary air damper shall modulate to its minimum position. As the space temperature rises above its setpoint, the primary damper shall modulate open.
   4.2. The supply air volume will be limited by its minimum and maximum supply air volume settings.
   4.3. When the air handling system is in warm-up mode or cool-down mode, the primary air damper shall be fully open.
   4.4. All VAV terminal units shall be addressable from the standalone controllers.

5. VAV Box with Reheat
   5.1. The VAV terminal box controller monitors the space temperature sensor and velocity sensor. The controller shall modulate the cold supply air damper and modulate the reheat valve to maintain the desired room temperature. If the space temperature is below its adjustable setpoint, the primary air damper shall modulate to its minimum position. On further drop in space temperature below the setpoint, reheat valve shall modulate open to maintain space temperature. As the space temperature

rises above its setpoint, the reheat valve shall be closed and the damper shall modulate open to maintain space temperature setpoint.

5.2. The supply air volume will be limited by its minimum and maximum supply air volume settings.

5.3. When the air handling system is in warm-up mode, the primary air damper and hot water control valve shall be fully open.

5.4. All VAV terminal units shall be addressable from the standalone controllers.

6. Unoccupied Mode :

6.1.1. In Unoccupied mode the VAV dampers shall modulate closed to its minimum position unless the terminal box is outside the unoccupied temperature setpoint range.

6.1.2. Space Temperature set point :

Operation Mode	Set Point
Heating	16ºC
Cooling	26ºC

7. Occupied Mode:

7.1.1. Space Temperature set point :

Operation Mode	Set Point
Heating	22ºC
Cooling	24 ºC

8. Group assignment to be determined on site to suit the operation requirements.

9. Alarms:

1.1. The following points shall alarm at the operator workstation:

Description	Low	High	Time Delay
Space temperature	15°C	30.0°C	15 min

CS102 – Fan Powered Box Controls

Applicable System: Fan powered boxes

Sequence:

1. The system is monitored and controlled by the Building Automation System (BAS).
2. For rooms 1162, 1159 and 1161, provide full feature thermostat with space temperature adjustment and space temperature, humidity and CO2 monitoring. For all other spaces provide sensor with space temperature monitoring and adjustment capabilities.

3. System Control:
   - 3.1. Schedule:
     - 3.1.1. The system operates via pre-programmed occupancy time schedule. Coordinate final occupancy schedule with Owner.
   - 3.2. Manual Override:
     - 3.2.1. Override On:
       - 3.2.1.1. The operator's command on BAS shall override the time schedule and optimum start and stop control and revert the system into normal or low occupied mode.
     - 3.2.2. Override Off:
       - 3.2.2.1. The operator's command on BAS shall override the time schedule and optimum start and stop control and revert the system into unoccupied mode.

4. Fan Powered Box
   - 4.1. The FPVAV series type with reheat fan shall run continuously during occupied periods. The FPVAV terminal box controller monitors the space temperature sensor and velocity sensor. The controller shall modulate the cold supply air damper and modulate the reheat valve to maintain the desired room temperature. If the space temperature is below its adjustable setpoint, the primary air damper shall modulate to its minimum position. On further drop in space temperature below the setpoint, reheat valve shall modulate to maintain space temperature. As the space temperature rises above its setpoint, the reverse shall occur.
   - 4.2. The supply air volume shall be constant and primary air will be limited by its minimum and maximum supply air volume settings.
   - 4.3. When the air handling system is in warm-up mode, the primary air damper and the reheat shall have full output.
   - 4.4. All FPVAV terminal units shall be addressable from the standalone controllers.
   - 4.5. During unoccupied periods, FPVAV shall act as unit heaters to maintain unoccupied heating setpoint. Fan shall be enabled and reheat shall have full heating capabilities.

5. Unoccupied Mode :
   - 5.1.1. In Unoccupied mode the VAV dampers shall modulate closed to its minimum position unless the terminal box is outside the unoccupied temperature setpoint range.
   - 5.1.2. Space Temperature set point :

Operation Mode	Set Point
Heating	16ºC
Cooling	26ºC

6. Occupied Mode:
   - 6.1.1. Space Temperature set point :

Operation Mode	Set Point
Heating	22ºC

Cooling	24 ºC

7. Group assignment to be determined on site to suit the operation requirements.

8. Alarms:
   1.1. The following points shall alarm at the operator workstation:

Description	Low	High	Time Delay
Space temperature	15°C	30.0°C	15 min
Space humidity	15%	75%	15 min
Space CO2	-	1400 ppm	15 min

ELECTRICAL GENERAL REQUIREMENTS
26 01 01

1 REQUIREMENTS

1.1 General Contract Documents

.1 Comply with General Conditions of Contract, Supplementary Conditions and Division 01 - General Requirements.

1.2 Work Included

.1 Work to be done under this section to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

1.3 Document organization

.1 Applicable Divisions for Electrical Work:

.1 Division 26 - Electrical

.2 Division 27 - Communications

.3 Division 28 - Electronic Safety and Security

.2 For clarity, any reference in the Contract Documents to Division 26 includes Division 27 and 28.

.3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.

.4 Contractor is responsible for completion of the Work whether or not portions are sublet.

1.4 UTM communication cabling specification applies fully to Division 26, 27 and 28, no exceptions.

.1 Division 27 contains work requirements that are applicable to the Work of Divisions 26 and 28.

1.5 Definitions

.1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in these Specifications, mean that the material or item referred to is "indicated", "shown", "listed" or "noted" on the Drawings or in the Specifications.

.2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in these Specifications, mean that the material or item referred to, is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by" the Owner/Client.

.3 Instructions using any form of the word "provide", requires the Contractor to furnish labour, materials and services as necessary to supply and install the referenced item.

.4 The term “building code” means the current edition of the “Ontario Building Code”.

.5 The terms “electrical code” and “electrical safety code” mean the current edition of the “Ontario Electrical Safety Code”.

.6 The terms “electrical authority” and “electrical safety authority” mean the “Electrical Safety Authority, ESA” The term “AHJ” means the “Authority Having Jurisdiction” and can include the local building inspector, the local fire department and the electrical safety inspector or their agents.

1.6 Language

.1 Specifications are written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where the list follows a semi-colon (;) punctuation is for clarity, where the list follows a colon (:) punctuation is to be read as short-hand form of verb “to be” or “to have” as context requires.

.2 It is not intended to debate with the Contractor reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.7 Examination

.1 Examine any existing buildings and services, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the Work.

.2 Examine work of other Divisions before commencing the Work, and report any defect or interference.

.3 No allowance will be made for any expense incurred through failure to make these examinations of the site and documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

1.8 Design Services

.1 Provide design services for elements of the Work where specified. Instruments of this service to be sealed by a professional engineer licensed in the applicable jurisdiction.

1.9 Standard of Material and Equipment

.1 Provide materials and equipment in accordance with Division 01.

.2 Materials and equipment:

.1 new and of uniform pattern throughout the Work,

.2 of Canadian manufacture where obtainable,

.3 labelled or listed by Code and/or Inspection Authorities, CSA certified and CMB listed; where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority,

.4 standard products of approved manufacture,

.5 in compliance with Standards and Regulations with respect to; (a) chemical and physical properties of materials,
(b) design,
(c) performance characteristics, and
(d) methods of construction and installation,

.6 identical units of equipment to be of same manufacture,

.7 within any unit of equipment, identical component parts to be of same manufacture, but various component parts comprising the unit need not be from one manufacturer.

.3 Materials and equipment are described to establish standards of construction and workmanship.

.1 Where manufacturers or manufacturers' products are identified in lists with phrase "Standard of Acceptance", these are manufacturers and/or products which meet standards with regard to performance, quality of material and workmanship.

.2 Manufacturers and/or products used are to be chosen from these lists.

.4 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make a complete and operating system.

.5 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.

.6 Provide equipment marked for use with 75°C wiring or with a higher temperature rating. If equipment is not marked with a temperature rating or if the only rating available is less than 75°C, increase the associated conductor sizes accordingly, to the satisfaction of the consultant.

.7 Factory fabricate control panels and component assemblies.

.8 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.

.9 Materials and equipment not satisfying these selection criteria will be condemned.

.1 Remove condemned materials from job site and provide properly selected and approved materials.

1.10 Substitutions

.1 The use of a substitute article or material which the manufacturer represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions;

.1 a substitution will not be considered for reasons of meeting the construction schedule unless the Contractor can demonstrate to the satisfaction of the Consultant that all reasonable efforts have been made to procure the specified product or material in a timely fashion,

.2 the manufacturer to advise the Consultant of the intention to use an alternative article or material before doing so,

.3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer, the manufacturer to supply all information necessary, as required by the Consultant, at no addi- tional costs to the contract,

.4 the Owner to be the sole judge as to the quality and suitability of alternative materials and the Owner's decision to be final,

.5 where use of an alternative material involves redesign or changes to other parts of the Work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,

.6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed, such request to be made in ample time to permit appropriate review without delaying the Work, taking into consideration that such a substitution request may be rejected requiring that the product or material as originally specified be provided,

.7 whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the
specifications,

.8 the costs of testing required to prove equality of the material proposed to be borne by the manufacturer.

2 SUBMITTALS

2.1 Shop Drawings and Product Data

.1 Submit shop drawings, manufacturers and product data and samples in accordance with Section 01 33 05;

.1 Submit for each item of equipment.

.2 Submit shop drawings in the same unit of measure as used on the drawings. Both metric and imperial measures may be included.

.3 Submit shop drawings to consulant

.2 Include shop drawing cover sheet form prepared for this project, for each shop drawing, or, include the same information on the contractors submittal cover sheet:

.1 Provide the following information on each submission;

(a) Client/Architect name
(b) Project Name
(c) Quasar project number
(d) Date
(e) Contractor name
(f) Contractor reference No.
(g) Manufacturer's name
(h) Product type
(i) Specification section number
(j) Contractor trade: mechanical, electrical, elevators, or general trades
(k) If a re-submission, the Quasar reference number from the previous submission.

.3 Submit shop drawings in PDF format;

.1 If submitted in hardcopy format, submit in 11 x 17, black and white originals of graphic quality suitable for photocopying. Allow one additional week for processing of shop drawings submitted in hardcopy format.

.4 Manufacturers' printed product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.

.5 Submit manufacturers' data sheets with typed schedules listing manufacturers' and suppliers' name and catalogue model numbers for such items as fire alarm system components, etc.

.6 For luminaires, submit bound sets of luminaire cut sheets with manufacturers' names and catalogue numbers for all luminaires to be used on the project. Identify and arrange the luminaire cut sheets and catalogue numbers in the same sequence as the Specification Luminaire List.

.7 Shop drawings and product data to show;

.1 CSA or equivalent approval,

.2 dimensioned outlines of equipment,

.3 dimensioned details showing service connection points.

.8 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.9 Where applicable, include;

.1 wiring, single line and schematic diagrams,

.2 diagrams showing interconnection with work of other Sections,

.3 equipment elevations,

.4 component assemblies,

.5 trip settings,

.6 description of operation.

.10 Each shop drawing to be checked and stamped as being correct, by trade purchasing item, before drawing is submitted. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

2.2 Field, Fabrication, or Installation Drawings

.1 Contractor's field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal will be returned identifying that the submitted drawings have not been reviewed.

.2 Maintain a copy on site of such drawings for reference by the Consultant.

.3 Upon request, provide a copy of such drawings to the Consultant for general information purposes.

3 APPLICABLE CODES AND STANDARDS

.1 All work shall be in accordance with Owner's design guidelines and UTM standards.

.2 Install electrical systems in accordance with the Electrical Safety Code (ESC).

.3 Install underground systems in accordance with the latest edition of CSA C22.3 No.7 except where specified otherwise.

.4 Abbreviations for electrical terms: to the latest edition of CSA Z85.

.5 Comply with CSA Certification Standards and Ontario Electrical Safety Code Bulletins in force at time of Tender submission.

.6 Where requirements of this specification exceed those of the above-mentioned standards, this specification to govern.

.7 In the event of a conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring the application of the most demanding requirements.

4 CONFINED SPACES

.1 Unless otherwise prescribed by the Constructor's/Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to;

.1 horizontal and vertical service spaces, shafts, and tunnels,

.2 inside of equipment which permits entry of the head and/or whole body, and

.3 ceiling spaces which are identified as containing a hazardous substance.

5 PERMITS, FEES AND INSPECTIONS

.1 Submit to Electrical Safety Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Consultant will provide drawings and specifications required by Electrical Safety Authority at no cost.

.4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.

.5 Furnish to Consultant, Certificates of Acceptance from Electrical Safety Authority and authorities having jurisdiction, upon completion of the Work.

6 EQUIPMENT

6.1 Manufacturers Nameplates

.1 Metal nameplate with raised or recessed lettering, mounted on each piece of equipment.

.2 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating, and approval listings.

6.2 Finishes

.1 Primary and final painting for Work, other than items specified as factory primed or finished, to be done under Finish Division 9.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.4 Leave a quart can or a pressurized spray can of paint, as used with switchboards, with Owner for touch-up purposes.

.5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.6 Store electrical materials and equipment such as switchboards, panels, transformers, bus ducts, fire alarm devices, luminaires, etc., in a dry, clean location and cover with polyethylene plastic to preserve factory finish.

.7 Protect exposed or free-standing equipment with plastic to minimize entry of dust and dirt and marring of finished surfaces during progress of work.

.8 Schedule luminaires, lamps, diffusers and fire detectors for installation as late as possible during construction in order to minimize accumulation of dust and/or dirt on them. Clean luminaires and diffusers, not acceptable because of dust and dirt, in an approved manner in accordance with the manufacturer's instructions. Wrap surface mounted and suspended luminaires and fire detectors, installed prior to painting or dusty construction being completed in the area, in plastic to prevent dirt or paint from settling on them.

.9 Wrap bus ducts in heavy gauge plastic to adequately prevent moisture and dirt from entering bus duct. Wrapping to remain until bus ducts are ready to be energized.

7 OFFICE, STORAGE & TOOLS

7.1 Office and Storage

.1 Provide temporary office and lunchroom facilities, workshop, tools and material storage space. Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.

.2 Assume responsibility for these facilities.

.3 Provide power, heat, light, telephone and internet services.

.4 Owner's cafeteria is off limits.

7.2 Appliances and Tools

.1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, as required to carry out the Work.

8 COORDINATION

8.1 General

.1 Consultant's drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductbanks, conduits, cabletrays, feeders, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

.2 Lay out and coordinate the Work to avoid conflict with work under other Divisions.

.3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of the Work.

.4 Where equipment provided under other Divisions connects with material or equipment supplied under this Division, confirm capacity and ratings of equipment being provided.

.5 Take information involving accurate measurements from dimensioned Architectural Drawings or at the building.

.6 Install services and equipment which are to be concealed, close to the building structure so that furring is kept to minimum dimensions.

.7 Location of conduit, bus duct, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.8 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the Work as an operating installation.

8.2 Field, Fabrication, and Installation Drawings

.1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services and to demonstrate coordination with work of other trades.

.1 Drawing scale: minimum 1:50 (1/4"=1'-0")

.2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.3 Layout equipment and services to provide access for repair and maintenance.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 “This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants’ review.”

8.3 Cutting and Remedial Work

.1 For details of cutting and patching and division of Work refer to Division 1.

.2 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade, whose work is involved, to do such cutting and patching. Pay for any resulting costs.

.3 Neatly cut or drill holes required in existing construction to accommodate equipment such as cables, raceways, bus ducts, cable trays, etc.

.4 Arrange and pay for cutting and patching as required for the Work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant’s approval of location and methods in writing. For weather exposed or moisture resistant elements or sight exposed surfaces, employ the original installer or an expert in finishing of the material, to perform cutting or patching.

.5 Layout cutting of structural elements, such as floor slabs, walls, columns or beams and obtain approval before starting work. Conduct a ground penetrating radar scan for reinforcing rods with structural or grade slabs and review with the Structural Engineer. GPR scan is to penetrate the complete depth of the slab

.6 Arrange and pay for supplemental ground penetrating radar (GPR) examination to locate concrete reinforcement, conduits and other embedments. Submit GPR results and obtain approval before starting work.

.7 Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Repair and reroute any circuits damaged by core drilling.

8.4 Voltage Ratings

.1 Operating voltages: to latest edition of 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. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

8.5 Wiring of Mechanical Trades Motors

.1 To limit responsibility and to specifically define the Work under this Division, use the following procedure with regard to motors provided under Mechanical Division 20.

.2 The Contractor under Mechanical Division 20 will be responsible for installing equipment which he supplies including motors, starters, disconnect switch, Motor Control Centres, “mechanical” panelboards and miscellaneous controls of the type specified.

.3 In every instance whether pertaining to Plumbing, Air Conditioning, Refrigeration, Heating or Ventilating equipment, wire to line side of the Motor Control Centre, panelboard, disconnect switch, or starter provided by these trades, in reasonable proximity to equipment being controlled.

.4 From this point, unless otherwise noted, the cost of electrical material and labour will be borne by the particular trade whose work is involved. That trade will mount starter and wire from it to motor being controlled, together with control wiring, remote switches, and pilot lights.

.5 Where individual starters and controls are grouped together, the Contractor under Mechanical Division 20 will provide a panel for mounting his equipment. Provide a feeder, main fused disconnect switch, a splitter of adequate size and capacity, individual fused disconnect switches, and wire to line side of the Division 20 starters.

.6 In the case of unit heaters, reheat coils, electrical control devices, and cabinet unit heaters, terminate wiring in an outlet immediately adjacent to motor or device being electrically powered. Wiring from this point to starter, thermostat, or other devices will be done under Mechanical Division 20.

.7 Provide branch circuit wiring and an outlet for each motorized damper or heating control.

.8 Ascertain exact locations of starters, Motor Control Centres, “mechanical” panelboards and motors, from Mechanical Drawings.

.9 Motors up to and including 0.25 kW (1/3 HP) to be 120 volt, 60 Hz, single phase.

.10 Motors 0.37 kW (½ HP) and above to be 3 phase, 60 Hz, voltage as noted.

9 PROTECTION OF PERSONNEL, WORK, AND PROPERTY

9.1 Personnel Protection

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment.

Keep these doors locked except when under direct supervision of electrician.

.4 Do not leave conduit, wires, cables, tools, equipment or materials in such a way that they constitute a hazard.

.5 Provide guards around openings in the roof or floor to prevent stock or scrap from dropping down.

.6 Remove loose equipment and tools from overhead areas before leaving each day.

.7 Do not leave boards with protruding nails on the floor.

.8 Cut off bolts at floor level to eliminate a possible tripping hazard.

9.2 Protection During Construction

.1 Provide protection required to enable existing building and equipment to remain in continuous and normal operation.

.2 Take the necessary precautions to protect equipment, existing building and service from damage during the Work. Accept responsibility for any damage and make good without cost to the Owner.

.3 It is of vital importance, during work of this Contract, that all existing surfaces and items are not damaged in any way whatsoever by the work of all trades. Take precautions as necessary to prevent damage to walls, floors, ceilings, windows, doors, door frames, mouldings, finishes, piping, ductwork, light fixtures, etc. Provide protection, hoarding, tarpaulins, dust sleeves etc., as required. Any damage caused because of lack of adequate protection to be made good at no cost to the Owner.

.4 Take care when working above or around UPS modules, batteries and switchgear as this equipment must remain in service.

.5 Take care to eliminate dust in equipment areas.

.6 Protect switchgear fronts from accidental breaker trips when working around or above them. Provide an extended shield constructed of12 mm (½") fire retardant plywood a minimum of 450 mm (18") from board front to allow access to board.

9.3 Core Drilling

.1 Wherever core drilling is required, provide temporary dust proof screens.

.2 In areas where core drilling through a slab in an operating facility is necessary, the areas to be drilled to be marked out clearly on the underside of slab. Owner's representative to be notified at least 1 week prior to core drilling operation. Provide tarping of equipment supervised by the Owner.

.3 During core drilling operations, station at least one person directly below the area of drilling with a large plastic container pressed to underside of slab to capture and hold core and water upon completion of operations.

.4 A wet/dry commercial quality vacuum to be used continuously at location of drilling operation to remove all excess water from the area.

9.4 Temporary Dust Proof Screens

.1 Provide temporary dust proof screens where required to separate work areas from completed areas and/or existing areas, to prevent dust from settling on the Owner's plant and equipment.

.2 Dust proof material to be neoprene coated nylon tarpaulin or other types of fabric as approved by the Consultant.

.3 Provide temporary framing as required.

.4 Extend dust proof screens from floor to underside of floor or roof above. Lap sections of screen sheets 150 mm (6") minimum and tape joints.

.5 Secure screen sheets at top, bottom and ends and tape perimeter.

.6 Co-operate with Owner in the erection of temporary dust proof screens.

.7 Remove screens when and as directed by Consultant.

9.5 Protection of Floors During Equipment Installation

.1 Provide protection of floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.

.2 Install 19mm (¾") plywood over 6 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish.

.3 Repaint or re-tile any floors or walls damaged or scratched during construction.

9.6 Housekeeping

.1 Maintain a high level of cleanliness.

.2 Remove scrap and refuse from the work area daily.

.3 Whenever possible, clean up immediately following completion of work.

.4 Deposit oily and waste solvent rags in approved containers to minimize the fire hazard.

.5 Sweep and damp mop daily.

10 WORK IN EXISTING BUILDING

10.1 General

.1 During the tender period, perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of the as built conditions to determine the scope of renovation and demolition work required prior to submitting a tender.

.2 The Work includes changes to the existing building and changes at junction of old and new construction. Route cabling, ducts, conduits and other services to avoid interference with existing installation.

.3 Core drilling to be done evenings after 11:00 pm. Coordinate with Owner.

.4 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services as necessary to accommodate the Work.

.5 Maintain or relocate existing services which pass through the area of renovation or demolition, but which feed items located outside of these areas. Rewire devices to the original circuits.

.6 Remove existing lighting fixtures, wiring, devices and equipment to suit new construction. Cut back and cap conduits and electrical outlets not being used, so that finished work presents a neat and
clean appearance. Disconnect at point of electrical supply, remove obsolete wiring and conduits, and make existing systems safe. Blank off openings in panels or boxes created by the removal of cables, conduits, wireways or ducts.

.7 Where an existing ceiling is to be removed and reinstalled or replaced under another trades scope of work, and the existing electrical items such as luminaires, fire detectors, speakers, exit signs, emergency lighting heads etc., are to be reused, provide the following regarding the electrical items:

- .1 remove,
- .2 store in a secure, clean, dry location,
- .3 install in the new ceiling, extend wiring and raceways as necessary,
- .4 provide new items to match existing where existing items have been lost or damaged,
- .5 make connections,
- .6 clean,
- .7 relamp luminaires,
- .8 test,
- .9 verify fire alarm devices,
- .10 replace defective items with new, then retest/reverify,
- .11 submit test and verification reports.

.8 Turn over designated materials and equipment to the Owner. Dispose of unwanted materials and equipment.

.9 Review removed luminaires and equipment with the Owner's representative, and if the Owner instructs they wish to keep any items, move them to a designated location on the site. Luminaires and equipment that the Owner does not want become the property of the Contractor and are to be taken from the site and disposed of appropriately.

.10 For devices, fixtures and equipment to be relocated, provide junctions boxes, outlet boxes, wiring, plates, supports, etc., as necessary.

.11 Revise panelboard directories accordingly if affected by the Work.

.12 Clean and relamp relocated luminaires and replace any faulty ballasts.

.13 On completion of relocations, confirm that relocated devices and luminaires are in proper working order.

.14 Co-ordinate work affecting fire alarm system, fire safety, or protection systems with the Owner, Consultant, fire alarm system manufacturer and authorities having jurisdiction prior to commencing work. Retain the original fire alarm system manufacturer to verify relocated fire alarm devices, modified equipment and revised wiring. Provide temporary fire protection and/or a fire watch in

all areas affected by the demolition and as required by authorities having jurisdiction.

.15 Where the Owner wishes to take over renovated areas ahead of the project completion date and these areas are intended to be fed from the distribution systems in the new building, make temporary connections to the existing services in these areas. Reconnect to permanent services at a later date, when the new distribution systems are available.

10.2 Continuity of Services

.1 Keep existing buildings in operation with minimum length of shutdown periods.

.2 Make connections to existing systems at approved times.

.3 Obtain written approval, recording times when connections can be made.

.4 Repair any damage caused to existing systems when making connections.

.5 Provide premium time labour to tie-in feeders or wiring at night or on weekends.

.6 Provide temporary feeders and connections as required to maintain systems in operation where shutdown periods will exceed 8 hours, or extend beyond the allowable time frame determined by the Owner.

.7 Arrange the Work so that physical access to the existing buildings is not unduly interrupted.

11 MOVING AND SETTING IN PLACE OWNER'S EQUIPMENT

11.1 S.B.O. (Supplied by Owner)

.1 Items marked SBO on drawings will be;

.1 purchased by Owner,

.2 received, checked, stored, unpacked, uncrated, assembled and located by the Contractor under Division 1

.2 Connect electrical services to this equipment.

11.2 E.R. or Ex. Rel. (Existing Relocated) or otherwise so identified

.1 Except as indicated below, items so marked on drawings will be moved from their present location and reinstalled by the Contractor under Division 1. Disconnect and reconnect electrical services to accommodate the relocation of this equipment.

.2 Disconnect, remove, store as necessary, move into place, reinstall, clean and reconnect electrical items so marked, such as;

.1 luminaires,

.2 fire detectors,

.3 speakers,

.4 switches,

.5 receptacles,

.6 disconnects,

.7 splitters,

.8 panelboards,

.9 switchgear,

.10 transformers,

.11 etc.

12 FINAL CLEANING

12.1 General

.1 Do final cleaning in accordance with Section 01 74 23.

.2 Perform final cleaning after construction activities, that create dust, have been completed.

.3 Clean electrical equipment and devices installed as part of this project.

.4 Clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt, including the top surface, whether exposed or in the ceiling space.

.5 Clean switch, receptacle, and communications outlets, cover plates, and exposed surfaces.

.6 Clean and vacuum any smoke detectors exposed to construction dust, do not use compressed air.

.7 Electrical rooms and electrical or communication closets:

.1 Thoroughly vacuum and clean interiors and buswork of switchboards, panels, cabinets and other electrical equipment of construction debris and dust prior to energization using a HEPA vacuum cleaner. Final clean using clean lint free cloths with a cleaning liquid as recommended by the manufacturer for the purpose.

.2 HEPA vacuum the top of switchboards, panels, cabinets, bus ducts, cable trays and conduits, and mechanical duct work in the room, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.

.3 Thoroughly re-clean as necessary prior to final turn over.

.4 Do not lay permanent switchboard matting in electrical rooms until rooms are thoroughly re-cleaned, and floors wet mopped and dried, immediately prior to final turn over.

13 RECORD DRAWINGS

.1 Provide record drawings in accordance with Section 01 78 39 and as specified herein.

.2 A set of design drawings in AutoCad 2010 on CD or DVD ROM will be provided by the Consultant. Make sets of white prints for each phase of the Work, and as the Work progresses and changes occur, mark white prints in coloured inks to show revisions. Dimension locations of ductbanks, conduits, maintenance holes, buried cables and similar buried items. Within the building, provide dimensions with respect to building column centres. Outside the building provide dimensions to the building foundation or to the centerline of paved roadways or provide GPS co-ordinates. Mark level with respect to an elevation which will be provided.

.3 Survey information from excavation and backfill of site services to be kept on site after approval and to be similarly transferred to white prints.

.4 Retain these drawings and make available to Consultant for periodic review.

.5 At 50%, 75% and 90% of project completion, scan marked-up drawings to Adobe .pdf format and submit a copy to the Consultant, or to the project document portal if one is in use.

13.2 As-built Drawings

.1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad 2010 (CAD) files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.

.1 Follow the Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.

.2 The Consultant's CAD files might not reflect all or any construction changes.

.2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. “Bubble” these revisions, and place these annotations on a separate and easily identified drawing layer.

.3 Show on electrical as-built drawings final locations of conduit, outlets, panels, branch wiring, system wiring, pull boxes, bus ducts, and equipment.

.4 Show on site services as-built drawings survey information provided by the Ontario Land Surveyor (OLS) monitoring the services installation.

.5 Identify each drawing in lower right hand corner in letters at least 12 mm (½") high as follows "AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include signature and stamp of OLS attached to note.

.6 Submit one (1) set of white prints of the draft as-built CAD files for the Consultant’s review.

.7 Once “AS BUILT DRAWINGS” white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to “As Built” condition to Consultants on CD or DVD ROM.

.8 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

14 OPERATING AND MAINTENANCE INSTRUCTIONS

14.1 Operating and Maintenance Data

.1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.

.1 Organize material in volumes generally grouped by Division

Section; (a) Site services,
(b) Power,
(c) Lighting,
(d) Low Voltage Systems,
(e) Fire Alarm and Security.

.2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to

bear; (a) Project Name,
(b) Project Number,
(c) Date,
(d) Trade Section, and
(e) List of Contents.

.3 Provide three hard-copies to Owner.

.2 In addition, provide Adobe PDF files for each document, produced from original direct-to-digital file creations.

.1 Organize documents into separate PDF files for each Division Section identified above, and apply Adobe Bookmarks to create Table of Contents.

.3 Include in operations and maintenance data;

.1 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 installation,

.2 technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists; advertising or sales literature not acceptable,

.3 wiring and schematic diagrams and performance curves,

.4 names and addresses of local suppliers for items included in maintenance manuals,

.5 reviewed shop drawings,

.6 operating characteristics of the equipment supplied such as calibration curves and coordination data to allow proper co-ordination with Owner's equipment,

.7 description of operation of the controls and protective devices used,

.8 maintenance and adjustment procedures,

.9 lifting and jacking instructions,

.10 fault locating guide,

.11 spare parts list and an itemized price list,

.12 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

.4 Approval procedure;

.1 submit one set of first draft of Operating and Maintenance Manuals for approval,

.2 make corrections and resubmit as directed,

.3 review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation,

.4 hand-over an additional two copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.

14.2 Operating and Maintenance Instructions

.1 Provide instructions to Owner's operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections. Include classroom instruction and hands-on instruction, delivered by competent instructors.

.2 Develop the proposed training plan, submit an outline of the training program for review and adjustment by the Owner. Obtain approval from the Owner before commencing training.

.3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each item of equipment, utilizing the services of the

manufacturers' representative as required.

.4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Repeat each training session approximately one week after the original session.

.5 Organize each pair of training sessions as follows:

.1 Power Distribution - Normal Power- Division 26

.2 Power Distribution - Emergency Power- Division 26

.3 Power Distribution – Other Systems- Division 26

.4 Communications – Division 27

.5 Electronic Safety and Security – Fire Alarm – Division 28

.6 Electronic Safety and Security – Security – Division 28

.6 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.

.7 Keep a record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

.8 For each training session, include the following topics;

.1 general purpose of the system (design intent),

.2 use of O & M manuals,

.3 review of single line drawings and control schematics,

.4 start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming, troubleshooting and alarms,

.5 interaction with other systems,

.6 adjustments and optimizing methods for energy conservation,

.7 maintenance requirements,

.8 special maintenance and replacement sources,

.9 health and safety issues,

.10 occupancy interaction issues, and

.11 system response to different operating conditions.

.9 Develop and provide training material, including printed documents and electronic presentation aids (eg. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and electronic format, in accordance with article on Operating and Maintenance Manuals.

.10 Sessions may be videotaped by the Owner as an aid to ongoing training of Owner's staff.

15 CARE, OPERATION AND STARTUP

.1 Arrange and pay for services of manufacturer's factory service technicians to supervise start-up of installation, check, adjust, balance and calibrate components.

.2 Provide these services for such periods, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the

operation, care and maintenance thereof.

.3 Arrange and pay for services of applicable manufacturer's factory service engineer or certified independent testing organization to supervise initial start-up of specialized portions of installation and to check, adjust, balance and calibrate components including related wiring and controls. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of the installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

16 TESTING

.1 Conduct and pay for the following tests;

.1 power 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, communications,

.6 additional testing as specified in other Sections.

.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 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.

.4 Carry out tests in presence of Consultant.

.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.6 Submit test results for Consultant's review. Test electrical equipment to standards and function of specifications, applicable codes and standards in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

17 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. Revise circuit labelling as appropriate.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, report listing phase and neutral current on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

18 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as per equipment manufacturers' recommendations for each piece of equipment.

19 TEMPORARY AND TRIAL USAGE

19.1 General

.1 Temporary and trial usage by Owner of any electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance, is not to be construed as evidence of acceptance by the Consultant.

.2 Owner to have the privilege of such temporary and trial usage, as soon as the Contractor claims that said work is completed and in accordance with specifications, for such reasonable length of time as is deemed to be sufficient for making a complete and thorough test of same.

.3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

20 PRICING OF CHANGE NOTICES

.1 The value of a proposed change in the work shall be determined in one or more of the following methods;

.1 by time and material,

.2 by unit prices set out in the Contract or subsequently agreed upon,

.3 by labour and material costs submitted in a detailed quotation.

.2 In the case of changes in the Work to be paid for under the time and material or the unit price methods, the form of presentation of costs and methods of measurement shall be agreed to by the Consultant and Contractor before proceeding with the change. Keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices where applicable.

.3 In the case of changes in the Work to be paid for under the time and material or the labour and material method, the material costs are to be less trade discounts. Provide a 20% discount from list price for items included in the Allpriser catalogue or Electrical Price Guide.

.4 The detailed quotation referenced under the labour and material method is to include a summary of charges made up of three components: labour charges, material costs and fees.

.1 Labour Charges

(a) The labour hour estimates are to be based on the current NECA Columns 1 and 2 as applicable to the portion of the Work as agreed to by the Consultant manual of labour units.
(b) Labour costs are to include burden on wages such as taxes, worker compensation charges, CPP, EI, project insurance, safety meetings, estimating, as-built drawings, supervision, small tools, site facilities, labour warranty and clean up.
(c) The all-inclusive hourly labour rate applicable for quotations submitted for changes to the work is 1.9 times the base ICI Journeyman rate from the current collective agreement. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 2.3 times the base ICI Journeyman rate from the current collective agreement for electricians, plumbers or pipe fitters.
(d) The all inclusive hourly labour rate indicated above is to include:

- Collective Agreement relevant to the place of work (vacation pay, RRSP, Health & Welfare, RST of Health & Welfare, Pension, Union admin fund, ECA fund (or

others), Secretariat.

- Legislation as relevant to the place of work (Emp. Health Tax, E.I., CPP, WSIB, taxes)
- Project insurance, safety meetings, estimating, lay outs, site facilities, warranties, storage,
- clean up, office supervision and miscellaneous charges.

(e) Foreman Electrician, General Foreman, Superintendent rates shall be as for the calculated Journeyman rate above plus 10% of the base ICI Journeyman rate from the current collective agreement. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.

(f) No other overhead supervision hours will be permitted.

.2 Material Charges

(a) Material costs are to be less trade discounts. Provide a 20% discount for items included in the Allpricer catalogue or Electrical Price Guide.

.3 Fees

(a) The overhead and profit fee is to include for the Contractor's head office and site office expenses, project manager, assistants, site office and storage facilities, utility charges, site security, telephone and facsimile transmission costs, as builts, expendable small tools, financing costs, coffee breaks, site facilities, general clean up and disposal, security, storekeeper, and all other non-productive labour.

(b) Fees for overhead and profit are to be in accordance with the general conditions of the contract

21 CONSULTANT REVIEWS

21.1 General

.1 Consultant’s attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority having jurisdiction.

21.2 Site Reviews

.1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Do not use any such reported items, or lack thereof, as part of the project quality assurance program nor as a change to the scope of work nor as acceptance of the quality of the work.

.2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless indicated otherwise.

21.3 Milestone Reviews

.1 Specific milestone reviews may be conducted at key stages by the Consultant, including;

.1 before backfilling of buried services,

.2 before closing of shafts,

.3 before closing of walls,

.4 before closing of ceilings,

.5 equipment demonstration,

.6 Substantial Performance deficiency review,

.7 Total Performance deficiency review.

.2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements into the construction schedule.

.3 Prior to Work being concealed, notify the Consultant in writing seven (7) calendar days in advance of the planned concealment to arrange a site review, where required by the Consultant. Correct noted deficiencies before concealing the Work. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

21.4 Final Review

.1 At project completion submit written request for final review of mechanical and electrical systems.

.1 Refer to section 26 08 19 Project Close-Out.

.2 Include with the request a written certification that;

.1 deficiencies noted during job inspections have been completed,

.2 systems have been balanced and tested and are ready for operation,

.3 completed maintenance and operating data have been submitted and approved,

.4 tags are in place and equipment identification is completed,

.5 cleaning is finished in every respect,

.6 electrical panels, switchboards, cabinets, and equipment surfaces have been touched up with matching paint, or re-finished as required,

.7 spare parts and replacement parts specified have been provided and receipt acknowledged,

.8 As-built and Record drawings are completed and approved,

.9 Owner's operating personnel have been instructed in the operation and maintenance of systems,

.10 fire alarm verification is 100% completed and Verification Certificate has been submitted and accepted.

22 CORRECTION AFTER COMPLETION

22.1 General

.1 At completion, submit written guarantee, undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.

.2 Guarantee to encompass replacement of defective workmanship, parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.

.3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

END OF SECTION

ELECTRICAL BASIC MATERIALS AND METHODS
26 05 01

1 GENERAL

1.1 Scope

.1 Articles that are of a general nature, apply to each Section of Divisions 26, 27 and 28.

1.2 Work Included

.1 Work to be done under this section to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

2 ACCESS DOORS

2.1 Construction:

.1 Access doors, unless shown or specified otherwise:
- .1 constructed from galvanized steel sheet,
- .2 flush mounted,
- .3 concealed hinges,
- .4 180° opening door,
- .5 round safety corners,
- .6 anchor straps,
- .7 plaster lock,
- .8 screwdriver operated latches,
- .9 without visible screws,
- .10 finished prime coat only,
- .11 fire-rated, as required.

.2 Door metal thickness as follows:
- .1 up to and including 400 x400 (16" x 16"): 1.6 mm (16 gauge)
- .2 height or width larger than 400 (16"): 2 mm (14 gauge)

.3 Constructed of stainless steel for areas finished with tile or marble surfaces.

.4 Constructed of stainless steel with neoprene gasketted door where used in damp and high humidity areas.

.5 Fire rated where installed in fire rated walls or ceilings. Fire rating to match the rating of the wall or ceiling.

.6 With keyed cylinder locks, keyed alike, for areas subject to security risks, EG;
- .1 public corridors,
- .2 public washroom

.3 etc.

.7 Inside clear dimensions:

.1 approximately 400 mm x 400 mm (16" x 16") for hand access,

.2 at least 600 mm x 600 mm (24" x 24") where personnel are to enter through doors,

.3 larger where indicated or required.

.8 Submit access door shop drawings for approval as soon as possible after award of contract, showing size, type and exact location of access doors.

Standard of Acceptance
- Acudor
- Cendrex (up to 400 x 400 only)
- Elmdor (up to 400 x 400 only)
- Mifab (up to 400 x 400 only)
- Nystrom
- Williams Brothers – GP

2.2 Installation

.1 Provide access doors for locations where equipment requiring access, maintenance or adjustment is "built-in".

.2 Submit a list of proposed access door locations and obtain approval before commencing installation.

.3 Access doors to be installed under the Division in whose work they occur. Arrange for and pay cost of access doors and their installation.

.4 Access doors are not required in removable acoustic panel type ceilings.

.5 Size and locate access doors in applied tile, or in glazed or unglazed structural tile to suit tile patterns. Refer to Architectural Room Finish Schedule and details on Architectural drawings in this regard.

3 SLEEVES AND CURBS

3.1 Materials

.1 Sleeves for bus ducts, wireways and cable trays: minimum 3 mm (1/8") galvanized steel.

.2 Integral flashing clamp on sleeves that pass through floors with a waterproof membrane.

.3 Removable (non fire rated) sealing material: Duxseal or acceptable alternative.

.4 Fire rated sealing material: per Article “Fire Stopping”.

3.2 Installation

.1 Provide sleeves for bus ducts, wireways, conduits and cable runs passing through;

.1 concrete walls, beams, slabs and floors,

.2 fire rated walls, partitions and ceilings.

.2 Place and secure sleeves in concrete form work.

.3 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.

.4 Terminate sleeves flush with surfaces of concrete and masonry walls.

.5 Extend sleeves 100 mm (4") above finished floor.

.6 Size sleeves to accommodate fire stopping materials where required.

.7 Make watertight connections between sleeves and waterproof membranes.

.8 Fill any spaces between sleeves and masonry walls;

.1 with non-shrink grout,

.2 with a rated fire stopping material for rated walls.

.9 Seal spare sleeves and the space between sleeves and the through conduits, cables, wireways, bus ducts etc;

.1 using removable sealing material,

.2 using a rated fire stopping material for floors and rated walls,

.3 seal watertight where sleeves penetrate a floor slab.

.10 Sleeves in existing concrete and masonry walls and floors;

.1 cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with procedure set out in Article “Cutting and Remedial Work” in Section “Electrical General Requirements”,

.2 neatly cut or drill holes in existing construction,

.3 terminate sleeves flush with surfaces of concrete and masonry walls,

.4 extend sleeves 100 mm (4") above finished floor with flange, countersunk, and bolted down flush into floor surface,

.5 fill opening between sleeve and

wall; (a) with non-shrink grout,
(b) with a rated fire stopping material for rated walls.

.6 fill opening between sleeve and floor with rated fire stopping material with water barrier,

.7 seal as indicated above.

.11 Provide concrete curbs, minimum 100 mm (4") high above finished floor surrounding sleeves and openings for;

.1 conduits,

.2 cables,

.3 telephone cable risers,

.4 bus ducts,

.5 wireways,

.6 cable trays, and

.7 other openings for electrical services through slabs above grade.

.12 Size concrete curbs for bus ducts to provide sufficient area to adequately carry bus duct support brackets

.13 Size openings to accommodate fire stopping materials as required.

3.3 FIRE STOPPING

3.4 General

.1 Maintain the integrity of floor and wall fire separations around electrical raceways, cables, bus ducts and boxes passing through rated floors or walls.

3.5 Materials

.1 Materials to form a ULC or cUL listed firestop system to CAN/ULC-S115 “Standard Method of Fire
Tests of Firestop Systems”.

.2 Firestop system rating: minimum 2 hrs., higher where indicated.

.3 Submit shop drawings consisting of product technical data and ULC or cUL listing.

Standard of Acceptance
- Hilti Firestop Systems
- 3M
- A/D Fire Protection System Inc.
- Eastern Wire + Conduit

.4 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

3.6 Installation:

.1 Submit a complete fire stopping and smoke seal schedule to the Consultant for review. Include details, cut sheets, system description and location for each proposed fire stopping and smoke sealing application.

.2 Install firestopping in accordance with the manufacturer’s recommendations and in accordance with the ULC or cUL listing.

.3 Firestopping to be installed only by personnel trained by the manufacturer on the installation of such systems.

.4 Firestop system manufacturer’s training and inspection services:

.1 Provide the services of the firestop system manufacturer to provide training to trades performing the fire stopping. Create and maintain a log of those personnel who obtain training.

.2 Provide the services of the firestop system manufacturer to inspect the installation of the firestopping while in progress and a final inspection at completion of work. Provide a manufacturer’s inspection report to the Owner and Engineer.

.5 Seal space between penetrating service and sleeve or opening in fire rated floors and walls with a fire stopping and smoke sealing system.

.6 At time of application of materials, surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint, loose concrete or masonry and foreign materials.

.7 Wiring may penetrate a fire rated assembly provided it is enclosed in non-combustible conduit, and the passage of the conduit in turn is suitably sealed to the assembly with fire stop material.

.8 Where wiring with a combustible covering and not enclosed in non-combustible conduit penetrates a fire resistance rated assembly, group the wiring into separate fire sealed penetrations to ensure the overall diameter of the combined wire(s) in each penetration does not exceed 25 mm.

.9 Arrange single conductor metal sheathed cables to individually penetrate the fire rated assembly and be individually fire stopped.

.10 Where wiring is installed in cable trays and penetrates a fire rated assembly;

.1 terminate and independently support the cable tray on each side of the fire rated assembly, and

.2 provide sufficient working room to properly install and inspect the fire stopping materials and penetration.

.11 Smoke seal and fire stop electrical boxes that penetrate a fire rated wall using fire rated putty pads, install putty pads on the outside of boxes. Ensure access is provided to bonding connection for enclosure. Increase size of enclosure, as required, to suit.

.12 Co-ordinate installation of cast-in-place fire stopping devices with the Division responsible for the placement of concrete.

4 PENETRATIONS OF BELOW GRADE WALLS AND SLABS ON GRADE

4.1 Materials

.1 Expanding cement water stop material.

.2 Submit manufacturer's literature.

Standard of Acceptance
- WATERSTOP-RX or acceptable equivalent

4.2 Installation

.1 Fit each cable, conduit and duct passing through floor slab in contact with ground or walls below grade, with a water stop.

.2 Submit schedule showing location, service.

.3 Install water stop in accordance with the manufacturer's instructions.

.4 Encircle each cable, conduit and duct and the perimeter of the wall opening with the water stop material.

.5 Fill the wall openings around the cables, conduits or ducts with hydraulic cement injected for the full width of the wall.

.6 Seal the exterior of the wall around the cables, conduits or ducts with a waterproof coating. Waterproof coating to be compatible with any existing waterproof

5 EQUIPMENT SUPPORTS, AND BASES

5.1 Supports for electrical work.

.1 Equipment supplementary supports to be provided by this Division.

.2 Concrete housekeeping bases for electrical equipment to be provided by this Division.

.3 Work to be done by firms specializing in these fields.

.4 Submit shop drawings for steel and concrete work, prepared by licensed Professional Engineers.

5.2 Supplementary supports and support brackets:

.1 Fabricated from structural grade steel with anchor bolts and fastenings.

.2 Designed in consultation with building structural consultant to transfer live loads and dead loads to building structural elements.

.3 Constructed as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

5.3 Concrete bases for housekeeping pads:

.1 Constructed using plywood form work and 20 MPa (3000 lb) concrete,

.2 Dowelled to concrete floor slab with steel rods not less than 13 mm (1/2 in) in diameter.

.3 Finish to make flat, level, smooth, neat surfaces.

.4 Chamfer corners 25 mm (1 in).

.5 Dimensions:

.1 75 mm (3 in) larger all around than base of apparatus for non-seismic applications,

.2 200 mm (8 in) larger all around than base of apparatus for seismically restrained equipment,

.3 Height: 100 mm (4 in)

.6 Reinforcing steel bars are required. Mesh reinforcement is not permitted.

5.4 Installation - General

.1 Locate supporting steel to permit service or repair, and to allow clear access to junction boxes and equipment.

.2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, and vibration mountings.

.3 Install anchor bolts, and vibration mountings between equipment and housekeeping pad.

.4 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.5 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggle.

.6 Make field connections with bolts to CAN/CSA-S16.1, or weld.

.7 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 After completion of erection, touch-up field welds, bolts and burnt or scratched surfaces with primer.

.9 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich es.paint.

6 GENERAL WIRING REQUIREMENTS

6.1 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

.2 Manufacturers' and CSA labels to be visible and legible after equipment is installed.

6.2 Location of Outlets

.1 Locate outlets in accordance with Division 01 - General Requirements.

.2 Do not install outlets back-to-back in wall.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'), and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

6.3 Mounting Heights

.1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 For Barrier Free areas verify the mounting heights with the authority having jurisdiction prior to rough- in.

.4 Install electrical equipment at following heights unless indicated otherwise. Coordinate with Architectural documents.

Description	General Area	Barrier Free
Local switches	1200 mm (47")	1050 mm (41")
Wall receptacles: General	300 mm (12")	450 mm (18")
Wall receptacles: Hospitals	450 mm (18")	450 mm (18")
Wall receptacles: above top of continuous baseboard	200 mm (8")	200 mm (8")
Wall receptacles: above top of counters or counter splash	175 mm (7")	175 mm (7")
Wall receptacles shown above top of counters where there is no counter: height above finished	1200 mm (47")	1050 mm (41")
Telephone outlets	300 mm (12")	450 mm (18")
Outlets for wall mounted telephones	1500 mm (59")	1000 mm (39")
Fire alarm pull stations	1500 mm (59")	1200 mm (47")
Fire alarm bells	2100 mm (83")	2100 mm (83")
Wall mounted speakers	2100 mm (83")	2100 mm (83")
Wall mounted door operator push pads	1000mm (39")	1000mm (39")
Wall or floor mounted, vertical panel type door operator controls	from ≤200mm to ≥900mm (from ≤7.9" to ≥36")	from ≤200mm to ≥900mm (from ≤7.9" to ≥36")
Television outlets	300 mm (12")	450 mm (18")
Panelboards	As required by code or as	As required by code or as

6.4 Conduit and Cable Installation

.1 Install embedded conduit prior to pouring of concrete.

.2 Arrange for holes through exterior walls and roof to be flashed and made weatherproof under Division 7.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.4 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions and assistance to locate and install inserts.

.5 Secure inserts firmly to form work before concrete is poured.

.6 Provide insert drawings as required.

6.5 Plywood Backboards

.1 Provide plywood backboards in electrical and telecommunications rooms and closets where

indicated or specified for mounting of equipment.

.2 Plywood to be securely attached to the building structure.

.3 Plywood to be 19mm, void free, good one side, mounted with good side exposed.

.4 Plywood to be Class A fire retardant, FSC certified and contain no added urea formaldehyde.

END OF SECTION

ELECTRICAL COORDINATION AND INSTALLATION DESIGNSERVICES
26 05 03

1 GENERAL

1.1 Scope

.1 Provide detailed coordination, fabrication, and installation design drawings for the services provided under Division 26. Cooperate with other trades and integrate the coordination drawings into the coordination drawings provided under Division 20.

.2 Provide the services of an experienced electrical and mechanical coordination supervisor to manage these contractors' design services. The supervisor is responsible for leading a multi-trade coordination effort including but not limited to: detailed inspection of existing conditions, layout and finalize routing of services, setting sleeves for structural openings and sequencing of service installation.

1.2 Document Ownership

.1 Ownership and copyright of Contractors coordination, fabrication, and installation design drawings remains with the Contractor producing these documents, subject to the requirements of the project agreement. In the absence of any requirements in the project agreement, the Contractor will provide the Owner with a royalty-free, transferrable, and irrevocable license to copy and use the materials for the purpose of operating and maintaining the building and building systems.

1.3 Consultant Drawings

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of bus duct, cable trays, conduit, ductwork, piping, bus duct, etc, and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

1.4 Design Commentary

.1 The following design commentary is provided to assist the contractor in developing an appreciation for the potential complexities and level of risk which may impact the preparation of a bid price for the Work. This commentary does not limit the scope of work nor does it address all potential risk factors associated with the Work.

- .1 Coordination of site services with utility room equipment layout;
- .2 Constricted space within ceiling areas for installation of all equipment and services;
- .3 Routing of fire-rated conductors;
- .4 Coordination of electrical and communication services with elevator system.

1.5 Requests for Information

.1 Requests for Information (RFI's or similar type of document) concerning coordination are to be submitted with sketch drawings indicating proposed solution for review by the Consultant. RFI's submitted without such proposals will be returned for re-submission.

1.6 Itemized Price

.1 Include costs associated with this Section as an Itemized Price in the Bid documents.

2 INTERFERENCE CO-ORDINATION DRAWINGS

2.1 General

.1 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.2 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.3 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.4 Location of conduit, bus duct, cable trays, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.5 Location of lighting fixtures, ceiling mounted devices, switches, outlets, and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.

.6 Include incidental material and equipment not specifically shown but which is needed to complete the work as an operating installation.

2.2 Interference Coordination Drawings

.1 Prepare interference coordination drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades. Drawings shall be prepared by a specialist firm experienced in CAD mechanical and electrical interference drawing production. Interference drawings are to include coordination with all mechanical and electrical services.

.2 Consult and co-operate with mechanical contractor to identify electrical services which are to be incorporated into the mechanical interference drawings.

.3 Conduct weekly meetings to discuss and resolve interference issues discovered during interference drawing production.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' general review."

.5 Drawing scale to be minimum 1:50 (1/4"=1'-0").

.6 Produce coordination drawings, preferably in 3D AutoCad MEP or Revit MEP format, and keep a set of drawings on site for Consultant's review.

.7 Obtain architectural and consultant's drawing files for background information, pending completion and return of any electronic file waiver forms.

2.3 Coordination with Other Trades

.1 Lay out and coordinate Work to avoid conflict with work under other sections of this Division and other Divisions.

.2 When equipment provided under other Sections or Divisions connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

2.4 Interconnecting Control and Power Wiring

.1 Provide wiring block diagrams and detailed termination drawings for controls and interlock wiring and connections to equipment and instrumentation, for both Owner's supplied equipment and equipment provided under Divisions 9 to 13. Provide wiring terminal numbers specific for each equipment connection.

2.5 Power and Control Wiring for Division 20

.1 Provide wiring, conduit, boxes and terminations for all mechanical equipment, as required.
Coordinate demarcation of work between Division 20 and Division 26 trades to provide complete system.

2.6 Fire Alarm and Building Automation System

.1 Provide a wiring coordination interface drawing for termination of fire alarm annunciation circuits to Building Automation System I/O equipment and/or motor starters, adjustable frequency drives, dampers, and motorized fire dampers.

.2 Drawings to include wiring terminal numbers and description label for FAS annunciation zone.

2.7 Owners Equipment and Relocated Equipment

.1 The service provisions shown for Owner's supplied equipment and/or relocated equipment is based on the best available information at the time of design. Examine the actual service requirements for this equipment and adjust as necessary to connection sizes of service drops to suit. A change (increase or decrease) in one trade size for electrical conductors, conduit and service breakers will be provided at no change to the construction cost.

.2 Where actual service requirements (except as described above for size) are different between the Consultant's drawings and Owner's equipment requirements, submit proposal for new or deleted services or capacities to the Consultant for review.

3 FABRICATION AND INSTALLATION DRAWINGS

.1 On an as-needed basis, prepare fabrication, spooling, and/or installation drawings based on the completed interference coordination drawings. CAD drawing system is in accordance with Contractor's company standards.

.2 Drawing scale: same as the interference coordination drawings or at larger scale as needed.

.3 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.4 Layout equipment and services to provide access for repair and maintenance.

END OF SECTION

EXCAVATION AND BACKFILL
26 05 05

1 GENERAL

1.1 General Requirements

.1 Coordinate with the site services work to be performed under other Divisions of the Work.

.2 Drawings are schematic and show the approximate routing of underground conduits, ducts, cables and duct banks.

.3 Contractor responsible for providing site locates for all existing underground services prior to commencing any excavation or digging.

1.2 References

.1 Occupational Health and Safety Act and Regulations for Construction Projects and Industrial Establishments as applicable.

1.3 Work Included

.1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

2 PRODUCTS

2.1 Aggregates

.1 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to
CAN/CGSB-8.1.

.2 Fine aggregates to be one, or blend of the following:

.1 Natural sand,

.2 Manufactured sand,

.3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.3 Coarse aggregates to be one of or blend of the following:

.1 Crushed rock,

.2 Gravel composed of naturally formed particles of stone.

2.2 Concrete

.1 As specified in Division 3, Cast-in-Place Section.

2.3 Warning Tapes

.1 Non-Detectable Warning tape:

.1 Suitable for direct burial,

.2 Polyethylene,

.3 150 mm (6”) wide,

.4 continuous black lettering on red background, indicating buried electrical services below.

.2 Detectable warning tape:

.1 Waterproof and corrosion proof, suitable for direct burial,

.2 Detectable from grade using a metal detector,

.3 Metallic core encased in polyethylene or polyester

.4 continuous black lettering indicating buried electrical services below.

3 EXECUTION

3.1 Preparation Prior to Excavation

.1 Carefully review drawings of other trades.

.2 Examine Architectural Drawings to determine where excavations for this Work interfere with new or existing paved areas, curbs, walks, concrete floors and other finished floors.

.3 Obtain current “locates reports” for existing buried services from:

.1 local government source,

.2 service providers as applicable, or

.3 a professional locate service.

.4 Review “locates reports” for any interferences with the Work.

.5 Carefully check on site, the actual locations of existing services shown on the drawings and report any serious discrepancies.

.6 Layout the final routing of services.

3.2 Excavation

.1 Saw cut pavements, curbs and sidewalks before proceeding with excavation.

.2 Excavate as required for the Work, both inside and outside the building.

.3 Remove and dispose of concrete, masonry paving, walks, demolished foundations, rubble, and other obstructions encountered in course of excavation.

.4 Shore and brace excavations exceeding 1200 mm (48 in) in depth in accordance with applicable Occupational Health and Safety Act and provincial regulations.

.5 Provide bracing, shoring and underpinning as required to prevent movement or settlement of adjacent structures, earth, services, walks, paving, trees, curbs, adjacent grade.

.6 Carefully check and avoid disturbing or damaging any existing underground piping, conduit or other services uncovered during execution of the Work.

.7 Prior to any excavation close to building footings, obtain approval from project structural engineer.

.8 Do not excavate within the 45 degree splay of bearing from the bottom of any footing without

written permission from the project structural engineer.

.9 Do not disturb soil within branch spread of trees or shrubs that are to remain. Where excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.

.10 Make good at no cost to the Owner any damage caused by settlement resulting from the excavation.

.11 Cleanly cut and trim banks of excavations and shore as required to prevent caving in.

.12 Replace, in an acceptable manner, excavation which has been carried to a depth greater than shown or authorized, with10 MPa concrete, at no additional expense to Owner, to give a bearing value equal to that provided by undisturbed soil.

.13 Prepare excavation for underground services so that no portion of any conduit, duct, cable or duct bank bears directly against any rock or other hard surface.

.14 Form bottoms of trenches so that pipes, conduits, duct banks, etc. are supported on undisturbed soil and will not be subject to undue strain.

.15 Grade bottoms of excavation for conduits, ducts or duct banks to provide drainage to adjacent handwell.

.16 Report to the Consultant any unsuitable sub grade conditions.

.17 Remove rock encountered by drilling and wedging. Blasting will not be allowed unless approved and authorized in writing.

.18 Break up rocks and boulders removed from excavations as required to permit handling.

3.3 Protection

.1 Store excavated materials in acceptable locations and in a manner so as to minimize damage to existing surfaces.

.2 Cover excavated materials and provide protection to prevent runoff into local drainage facilities.

.3 Protect from freezing, excavated earth that is to be used for backfilling.

.4 Grade around excavations to prevent surface water runoff into excavated area.

.5 Keep excavations dry by bailing, pumping or other acceptable means.

.6 Cleanly cut and trim banks of excavations and shore as required to prevent caving in.

.7 Keep sides and bottoms of excavations from freezing and protect as required to prevent damage to the Work or to existing services, by weather or other conditions.

3.4 Backfilling

.1 Prior to backfilling, remove formwork, shoring etc.

.2 Do not commence backfilling until approval has been obtained from Authority Having Jurisdiction (such as the Electrical Safety Authority) and Consultant.

.3 Backfill as required for the Work, both inside and outside the building

.4 Provide detectable warning (tracer) tape directly above centerline of buried services.

.5 Provide non-detectable warning (marker) tape midway between buried services and finished grade.

.6 For trenches exceeding 500 mm (20") in width, provide two non-detectable warning (marker) tapes, one laid 100 mm (4") from each trench edge, midway between buried services and finished grade.

.7 Backfill excavations, required in close proximity to, or below footing level with 10 MPa concrete up to the top of highest adjacent footing.

.8 Where solid undisturbed soil is not obtainable at the trench level eg: adjacent to a foundation wall or maintenance hole, provide granular 'A' material from undisturbed soil, compacted in 300mm (12") layers up to bottom of trench.

.9 Do not use frozen earth for backfilling nor place any backfilling on or against frozen earth.

.10 Repair, at no cost to the Owner, any of the Work and existing services damaged during backfilling.

.11 Backfill trenches under building floors, roads and paved areas with sand placed in layers and compacted in an approved manner to achieve 95% modified Proctor compaction. Do not use material from excavation for backfilling.

.12 For conduits, ducts and cables;

.1 provide a base layer of sand at least 100mm (4") deep,

.2 tamp sand around and over conduits, ducts and cables, in 150 mm (6") layers to a height of at least 300 mm (12") above top of conduits, ducts and cables.

.3 compact each sand layer,

.4 fill remainder of trench in 300 mm (12") layers with approved excavated material, free from stone,

.5 compact each layer to prevent undue settlement.

.13 For duct banks at maintenance holes and foundation walls;

.1 backfill in 300mm (12") layers with Granular 'A' material to height of at least 300 mm (12") above top of duct banks,

.2 compact each layer,

.3 fill remainder of space in 300 mm (12") layers with approved excavated material, free from stone,

.4 compact each layer to prevent undue settlement.

.14 Where excavations interfere with new or existing paved areas, curbs, walks, concrete floors and other finished floors, backfill with sand.

.15 Patch paved areas, walls, walks, lawns and road surfaces, damaged by the Work, in an acceptable manner.

.16 Make up settlement of backfilling as soon as possible. Fill depressions to restore the

correct grade after a period, adequate to reveal settlement, has passed. Make good any subsequent settlement of such fill.

.17 Pay costs to make good paving, lawns, curbs and any other surfaces damaged by settlement and subsequent restoration.

.18 Dispose of excess excavated material and leave the site clean.

3.5 Informational and Warning Devices

.1 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from the Work that requires road user response.

.2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as required by the Provincial Standards.

.3 Place signs and other devices in acceptable locations.

.4 Meet with the Consultant prior to commencement of the Work to prepare a list of signs and other devices required. If the situation on site changes, revise the list, acceptable to the Consultant.

.5 Continually maintain traffic control devices in use by:

.1 Checking signs frequently for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance,

.2 Relocating, removing or covering signs and other devices which do not apply to the prevailing conditions,

.3 Adding signs and other devices to suit the prevailing conditions.

END OF SECTION

WIRES & CABLES 0-1000 VOLTS
26 05 19

1 GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 26 05 01 Electrical General Requirements.

1.2 Conductor sizes

.1 Conductor sizes are based on connected equipment having a temperature marking of 75°C or higher.

Where equipment does not have a temperature marking or it has a marking lower than 75°C, increase the size of the conductors accordingly, to the satisfaction of the consultant.

.2 For wires in conduit, conductor sizes are based on not more than 3 current carrying conductors in a conduit. Where more than 3 current carrying conductors are installed in a conduit increase the conductor size accordingly, to the satisfaction of the consultant.

.3 Do not reduce conductor sizes, conductors may have been oversized due to voltage drop constraints.

2 PRODUCTS

2.1 Building Wires

.1 Conductors: copper conductors, size as indicated.

.2 Minimum wire size: No. 12 AWG.

.3 Stranded conductors for 10 AWG and larger.

.4 Insulation:

.1 chemically cross-linked thermosetting polyethylene material,

.2 RW90 or RWU90 to CSA C22.2 No. 38,

.3 1000V and 600V ratings.

.5 Conductors to be colour coded. Conductors to have colour impregnated into insulation at time of manufacture. Phase conductors No. 8 AWG and larger, with black insulation, may be colour coded with adhesive colour coding tape.

Standard of Acceptance

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.2 Armoured Cables

.1 Type: AC90, 600V 90C to CSA C22.2 No 51, FT4 rated.

.2 Conductors: copper, minimum size #12 with bare copper #12 bonding wire.

.3 Insulation: RW90 XLPE.

.4 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

2.3 Armoured Cables (TECK)

.1 Type: TECK90, 600V to CSA C22.2 No 131.

.2 Conductors: insulated copper, quantity and size as indicated.

.3 Insulation: RW90 XLPE.

.4 Inner jacket; FT-4 rated PVC.

.5 Armour: interlocking steel for multiconductor cable, interlocking aluminum for single conductor cables.

.6 Bonding conductor:

.1 bare in multiconductor cables,

.2 bare concentric in single conductor cables,

.3 same material as phase conductors.

.7 Outer jacket: FT-4 rating with rating permanently identified on jacket.

.8 Connectors:

.1 Watertight,

.2 Equal to T&B Star Teck type,

.3 Non-magnetic connectors for single conductor cables.

Standard of Acceptance (armoured, aluminium sheathed and TECK cables)

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Northern Cables Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.4 Instrumentation and Control Cabling

.1 Control cables to CSA Standard CAN3-C2.1-M86 Control Cables - 600 Volts.

.2 Control cables as follows:

Conductors	Quantity, arrangement and gauge shown on drawings or specified elsewhere.
Identification	Colour coded or numbered.
Insulation	XLPE
Armour	Steel (No armour required if installed in conduit or approved wireway).
Jaket	FT4 Flame Retardant, FT6 when installed in open style cable trays in ceiling spaces that are used as return air plenums

.3 Shielded cables to provide 100% shield coverage complete with drain wire.

.4 Multipair twisted shielded cables to have individually shielded pairs, overall shield, drain wires and overall rated jacket.

Standard of Acceptance
- General Cable (Carol)
- Belden
- Nexans Canada Inc.

3 EXECUTION

3.1 General

.1 Conductor colour coding tbe as follows:

Phase A - Red
- Phase B - Black
- Phase C - Blue
- Neutral - White
- Ground - Green
- Control - Orange

.2 Where colour coding tape is utilized, apply at least 50 mm (2") at terminations, junction boxes and pull boxes. Do not paint conductors.

.3 Use:

.1 600 V insulation for 347/600 V and 120/208 V systems.

.4 Wiring installed underground: RWU90.

.5 Wiring in channel back of luminaires:

.1 600 volt type GTF or TEW,

.2 temperature rating as required by CSA and/or manufacturer requirements.

.6 Store wire and cable in a clean, dry, well ventilated area.

.7 Protect white insulated wire from exposure to NOx gas (eg: exhaust from propane fuelled equipment) by wrapping with shrink wrap, by locating away from sources of NOx and by maintaining adequate ventilation to minimize NOx levels.

.8 Where white insulated wire has discoloured:

.1 do not install,

.2 dispose of the wire,

.3 remove and replace wire that has been installed.

.9 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.

.10 Splice wires:

.1 Up to and including No. 6 AWG: with nylon insulated expandable spring type connectors with moulded thermoplastic body and expandable square edge design spring.

.2 Larger than #6 AWG: with compression sleeve connectors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.

.11 Do not splice conductors used in parallel runs.

.12 Where the Consultant agrees that splicing of conductors in a parallel run is unavoidable, connect the paralleled runs of the feeder together in a junction box at the splice location, using:

.1 Copper bus bars of quantity and size to match the circuit,

.2 A two-hole long barrel compression lug on each cable,

.3 Two nuts and bolts on each lug,

.4 Two oversized flat washers and a spring lock washer, or two Belleville washers, on each bolt,

.5 An oversized CSA Type 1 enclosure to house the above.

3.2 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 33.

.2 In wireways and auxiliary gutters in accordance with Section 26 05 37.

.2 Home runs, of 15 and 20 Ampere circuits to lighting and receptacle panels, which exceed:

.1 25 m (75') in length: No. 10 AWG or larger,

.2 40 m (120') in length: No. 8 AWG or larger,

.3 60 m (180') in length: No. 6 AWG or larger.

.3 Increase the size of branch circuit conductors and home runs as required so that the total voltage drop, from panelboards to loads, does not exceed 3% under load.

.4 For branch circuit wiring a common neutral conductor may be used with two or three phase conductors except where indicated otherwise.

.5 For branch wiring, common neutral conductors may be used in the following applications:

.1 lighting circuits, excluding dimming circuits,

.2 housekeeping receptacles,

.3 specific purpose receptacles for equipment that does not produce harmonic currents, such as resistance heating.

.6 Where wires are damaged or contaminated during installation, remove and dispose of wires, swab out conduits and pull in new, clean conductors.

3.3 Installation of Armoured Cables AC90 (BX)

.1 May be used for drops to surface and recessed mounted fluorescent luminaires.

.2 May be used for wiring concealed within walls provided that horizontal runs within the ceiling space do not exceed 2m (6 ft).

.3 Terminate cables in accordance with Section 26 27 28 - Wire and Box Connectors - 0 - 1000 V.

3.4 Installation of Armoured Cables ACWU and TECK

.1 Install and terminate cables in accordance with manufacturer's recommendations.

.2 Use non-magnetic connectors for single conductor cables.

.3 For single conductor cables in free air circuits rated up to and including 400 Amperes:

.1 Space cables one cable diameter apart throughout the run,

.2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained,

.3 Provide a 6mm thick aluminium termination plate at each end of the run,

.4 Size the termination plates to overlap the openings by at least 20mm on all sides,

.5 Seal the plates to the enclosures with silicone sealant and secure to the enclosures with nuts, bolts and lock washers every 150mm,

.6 Terminate all cables of the circuit on the same terminal plate,

.7 Connect the cable bonding conductors to the enclosure bonding lug or bus at each end of the run,

.8 Bond each aluminium termination plate to its associated enclosure.

.4 For single conductor cables in direct buried circuits:

.1 Space cables apart per Diagram D8 of the electrical code,

.2 Maintain cable spacing throughout the run,

.3 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings of not less than one cable

.4 At the supply end of the run:

(a) Provide a 6mm thick aluminium termination plate,

(b) Size the termination plate to overlap the opening by at least 20mm on all sides,
(c) Seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
(d) Terminate all cables of the circuit on the terminal plate,
(e) Connect the cable bonding conductors to the enclosure bonding lug or bus, (f) Bond the aluminium termination plate to the enclosure.

.5 At the load end of the run:

(a) Provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel, (b) Size the termination panel to overlap the opening by at least 20mm on all sides,
(c) Seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
(d) Terminate all cables of the circuit on the terminal panel,
(e) Cut off the cable bonding conductors at the connector and cover with insulating tape, ensure that the cable bonding conductors do not make any electrical contact,
(f) Ensure that the cable connectors do not make electrical contact with the enclosure.

.6 Install a separate bonding conductor for

the circuit: (a) Insulated RWU90 copper,
(b) Sized per the Electrical Safety Code,
(c) Run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,

(d) Separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables.

3.5 Installation of Instrumentation, Communication and Control Cabling

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 33.

.2 In wireways and auxiliary gutters in accordance with Section 26 05 37.

.3 In open style cable trays in ceiling spaces, using FT6 plenum rated cable assemblies.

.4 In open style cable trays in ceiling spaces, using FT6 or FT4 rated cable where the ceiling space is not used as a return air plenum, as directed by the Consultant.

.2 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.

.3 Run instrumentation, communication and control cabling point to point and terminate on terminal strips. Do not splice communication or control cabling. Where long runs make a continuous point to point installation impractical, make splices on labelled terminal blocks in an accessible labelled terminal cabinet, installed at 1200 mm (48") above floor, and indicate cabinet location, terminal and wire numbers on the As-built drawings.

.4 Terminate control cables in equipment with suitable connectors.

.5 Clearly identify cables at both ends, with permanent PVC wire markers, Weiland type Z or equal, indicating cable number and wire numbers.

END OF SECTION

GROUNDING AND BONDING SECONDARY
26 05 27

1 GENERAL

1.1 General Requirements

.1 Conform to Sections of Division 1 as applicable.
.2 Conform to UTM cabling spec grounding details and requirement

1.2 Related Sections

.1 26 01 01, Electrical General Requirements.

.2 26 05 01, Basic Materials and Methods.

.3 26 05 53, Identification for Electrical Systems.

1.3 References

.1 IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.4 Submittals

.1 Submit shop drawings and product data in accordance with Section 26 01 01 Electrical General
Requirements.

.2 Submit list of nameplates.

1.5 Applicable Codes and Standards

.1 Latest edition of CSA C22.2 No 41 Grounding and Bonding Equipment.

1.6 Work Included

.1 Provide labour, materials, and equipment as required for installation, testing and putting into proper operation complete systems as shown, as specified and as otherwise required.

1.7 Operation and Maintenance Data

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 01 01
Electrical General Requirements.

2 PRODUCTS

2.1 Clamps:

.1 non-corroding copper, bronze and/or stainless steel construction.

2.2 Conductors

.1 Insulated grounding and bonding conductors:

.1 bare, stranded, soft annealed copper,

.2 type RW90 green insulation.

2.3 Accessories

.1 Accessories including but not limited to:

.1 grounding and bonding bushings,

.2 protective type clamps,

.3 bolted type conductor connectors,

.4 bonding jumpers, straps,

.5 pressure wire connectors,

to be of non-corroding copper, bronze and/or stainless steel construction.

3 EXECUTION

3.1 Installation

.1 Ground electrical systems in accordance with the Electrical Safety Code and the latest edition of
ANSI/IEEE Standard 142.

.2 Bond electrical equipment in accordance with the Electrical Safety Code and the latest edition of
ANSI/IEEE Standard 142.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding and bonding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main and electrodes, using copper welding by exothermic process.

.6 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Provide a bonding wire for flexible conduit, connected at both ends to bonding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.9 Provide a separate bonding conductor in each conduit:

.1 sized as per Table 16 of the ESC,

.2 not less than #12 AWG copper,

.3 with one bond conductor for every three line conductors.

.10 Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections.

3.2 Equipment Bonding

.1 Install insulated copper bonding connections:

.1 sized not less than #12 AWG and not less than indicated in Tables 16 of the electrical code,

.2 to typical equipment including, but not necessarily limited to the following list:

(a) service equipment,

(b) transformers,

(c) switchboards,

(d) panelboards,

(e) splitters,

(f) disconnect switches,

(g) junction and outlet boxes,

(h) receptacles,

(i) luminaires,

(j) frames of motors,

(k) frames of generators (alternators),

(l) starters,

(m) fire alarm systems,

(n) security systems,

(o) CCTV systems,

(p) audio systems,

(q) communications systems,

(r) control panels,

(s) outdoor lighting,

(t) elevators,

(u) other equipment that is supplied with electrical power.

.2 Where applicable, run bonding conductors as part of the feeder.

.3 Where bonding conductors are run separately, install in PVC conduit.

3.3 Bonding of Other Items

.1 Install insulated copper bonding connections:

.1 sized not less than #6 AWG,

.2 run in PVC conduit,

.3 to typical items including, but not necessarily limited to following list:

(a) metallic water piping systems,

(b) metallic waste water piping systems,

(c) metallic gas piping systems,

(d) metallic vacuum piping systems,

(e) metallic compressed air piping systems,

(f) building steel work.

.2 Review the design and installation of each piping system with the system installer and provide bonding jumpers where necessary to ensure that each piping system is electrically continuous.

3.4 Field Quality Control

.1 Perform tests in accordance with:

.1 Section 26 01 01 - Electrical General Requirements.

.2 Section 26 08 05 - System Co-ordination, Verification and Testing.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.

.3 Perform tests before energizing electrical system.

END OF SECTION

FASTENINGS AND SUPPORTS
26 05 29

1 GENERAL

1.1 Related Work

.1 Fastenings and supports: Section 01 61 00 - Common Product Requirements.

.2 Concrete bases and housekeeping pads for electrical equipment shall be arranged and paid for by Division 26, and installed by trade specialists under respective Carpentry, Concrete, and Painting Divisions.

1.2 Shop Drawings

.1 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.

.1 Shop drawing details:

(a) construction detail drawings for each loading condition,
(b) span deflection calculations,
(c) building attachment load calculations and type.

.2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

2 PRODUCTS

2.1 Support Channels

.1 Hot dipped galvanized steel, U shape, size 41 mm x 41 mm x 2.5 mm (1 ½" x 1 ½" x 1/10") thick, surface mounted, suspended or set in poured concrete walls and ceilings.

2.2 Inserts

.1 Inserts for conduits and raceway hangers, for single, double and multiple runs shall be galvanized.

Standard of Acceptance
- Unistrut Canada
- Burndy (Canada) Ltd. - Flexibar
- Pilgrim Technical Products Ltd. - Tufstrut

2.3 Hangers

.1 Hangers for electrical conduit shall be hot dipped galvanized after fabrication.

Standard of Acceptance
- Burndy Canada Ltd.
- Canstrut
- Electrovert Ltd.
- E. Myatt & Co. Ltd
- Steel City Electric Ltd.
- Pilgrim Technical Products Ltd.

2.4 Trapeze hangers

.1 Performance:

.1 Manufactured:

(a) to product load listings.

.2 Custom fabricated:

(a) maximum deflection between supports: 1/250 (0.4%) of span
(b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.

.2 Construction:

.1 Carbon steel shapes, to suit load application:

(a) hollow steel section,
(b) equal leg El section, or
(c) double C channel “strong-back”, with welded clips.

.2 Hanger rods:

(a) as specified above, and
(b) minimum two support rods,
(c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.

.3 Finish:

.1 hot dipped galvanized finish in mechanical rooms and outdoors.

.2 black steel finish in other areas.

Standard of Acceptance
- Anvil Fig 45, 46, 50

3 EXECUTION

3.1 Installation

.1 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions to locate and install inserts.

.2 Secure equipment to masonry, tile and plaster surfaces with lead anchors.

.3 Secure equipment to poured concrete with expandable inserts.

.4 Secure surface mounted equipment with T-bar support hanger fastened to inverted T bar ceilings.

Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

Standard of Acceptance
- Caddy model No. 512 c/w BHC clip

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50 mm (2") and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm (2").

.3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm (¼") dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm (¼") dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels.

.9 Provide galvanized after fabrication metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables. Only materials rated for the purpose may be used.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.14 Supply and erect special structural work required for the installation of electrical equipment. Provide anchor bolts and fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.15 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown in or on structural tile walls, or walls that are inadequate to bear the equipment.

.16 Provide channel iron or other metal supports where necessary to adequately support lighting fixtures. Do not use wood. Lighting fixtures shall be supported totally independent of ceiling and supported from structure above.

.17 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members required between beams for supporting conduits.

.18 Do not use explosive drive pins in any section of work without obtaining prior written approval.

.19 Provide re-enforced concrete pads under switchboards, generators, and all other floor mounted electrical equipment. Pads are to formed with chamfered edges to prevent chipping. Pads are to be sealed and painted to prevent dust from entering and interfering with electrical equipment.

END OF SECTION

SPLITTERS, JUNCTION AND PULL BOXES, CABINETS
26 05 32

1 GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01 Electrical General Requirements.

1.2 Reference

.1 CSA C22.2 No. 76 Splitters.

.2 CSA C22.2 No. 40 Junction and Pull Boxes.

.3 Cabinets to Section 26 27 18 Panel Trim.

2 PRODUCTS

2.1 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs and connection bars to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters.

.4 Distribution riser splitters shall be of special construction with hinged access door, copper bus bars predrilled to accept two-hole compression connectors for all incoming and outgoing cables.

2.2 Junction and Pull Boxes

.1 Welded steel hot dipped galvanized construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

2.3 Cabinets

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface or flush mounting as indicated.

.3 Surface mounted cabinets shall be finished in ASA 61 grey.

2.4 Instrumentation and Control Terminal Cabinets

.1 Surface mounted, gasketed, drip proof and dust tight, JIC enclosure, CEMA type 12 With hinged door, lock, 2 keys, white raised and removable internal mounting panel, diagram pocket, finished with ASA 61 grey.

Standard of Acceptance
- Hammond

.2 Panel wiring to be contained in PVC wiring ducts complete with cover strips, minimum 50 mm x 50 mm (2" x 2"). Wireway fill to be limited to 60%. Where there are a large number of door mounted devices, door wiring harnesses shall also be contained in wiring ducts at rear door. All door wiring devices to emanate from the control panel terminal strips. Wiring to panel face mounted devices to be bundled neatly on hinge side of panel, enclosed in flexible spiral wrap, and installed such that wiring will not be damaged when opening and closing door. Ground panel door to panel with a flexible copper bonding strap. Label all wiring with permanent PVC sleeve type markers.

.3 Phoenix contact terminal blocks with mounting rails, end covers, terminal markers, partition plates and accessories: UK 2.5 termination of wiring 22 to 12 AWG; UK 5 and UK 10 series for current transformers and other leads #10 AWG and #8 AWG; UDK or UK 5 twin for connecting two or more conductors to one terminal block; DIK 1.5 for three wire sensor device wiring; MTKD for thermocouple leads.

.4 Provide lamacoid nameplates for all panel mounted control and indicating devices, and all internal components such as terminal strips, control transformers, control devices, relays, etc. as per 26 05 01.

3 EXECUTION

3.1 Splitter Installation

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes and Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m (6'-6") above finished floor.

.3 Install terminal block as indicated in Type T cabinets

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes for all wiring.

3.3 Identification

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical - General
Requirements.

.2 Install size 2 identification labels indicating system name, voltage, phase and source of power.

.3 Provide a typed directory in cabinets showing following information: Nature, actual quantities and room number of device or devices connected to each terminal, as well as signal circuit number where applicable.

END OF SECTION

CONDUITS, FASTENINGS AND FITTINGS
26 05 33

1 GENERAL

1.1 General Requirements

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General
Requirements.

1.3 Work Included

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.4 Location of Conduit

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

1.5 References

.1 CSA C22.2 No. 45 Rigid Metal and Epoxy Coated Conduit

.2 CSA C22.2 No. 83 Electrical Metallic Tubing

.3 CSA C22.2 No. 136 Rigid PVC Conduit

.4 CSA C22.2 No. 56 Flexible Metal and Liquid-Tight Flexible Metal Conduit

.5 CSA C22.2 No 211.2 Rigid PVC Conduit

.6 Conduit accessories, conduits and fittings to CSA C22.2 No. 18.

1.6 Wiring Methods

.1 Install wiring in surface mounted EMT conduit unless otherwise specified. In finished areas, conceal conduit in walls and ceiling spaces.

.2 Where shown on drawings, armoured cable shall be Teck 90 type. Jackets of cable shall have FT-4 rating identified. Connectors shall be equal to T&B Star Teck Type

.3 Rigid PVC conduit with ground wire as per Electrical Safety Code Table 16 shall be used throughout below grade areas and may be used in or under slab on grade areas. It shall not be used in above grade slabs.

.4 Rigid galvanized steel conduit shall be used throughout basement; in damp locations including but not limited to intake and exhaust shafts and air handling units; for rigid metallic

conduit underground or in floor slabs; for wiring outdoors and in unheated buildings; and where noted on Drawings.

.5 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass.

.6 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.

.7 Use rigid galvanized steel conduit for wiring where conduits are exposed to possible mechanical damage.

.8 Use epoxy coated rigid galvanized steel conduit or Schedule 40 rigid PVC for wiring in poured concrete or below grade.

.9 Aluminum conduits shall not be used.

.10 Flexible conduit and armoured cable will be accepted in parts of existing building, where furred spaces above ceilings are too congested to permit conduit to be installed, but only with Consultants written permission. Terminate armoured cable, where shown, in accordance with the manufacturer's recommendations.

.11 Flexible steel conduit with integral insulated green ground wire is permitted for the final connection to luminaires mounted in suspended ceilings from the branch wiring junction box above, with flexible conduit length not to exceed 2 m (6'), and be neatly installed and attached to luminaire support chain.

.12 Flexible armoured conduit (or BX) with an integral insulated green ground wire may be used where concealed in walls for wiring to receptacles, and for the final connection to luminaires.

.1 The junction box interfacing the horizontal EMT conduit to the flexible conduit shall be located within 2 m (6') horizontally from the end device in open areas, and in enclosed rooms, located in the same room as the devices being served, in reasonable proximity to the walls, in order to keep the horizontal portion of the run of flexible conduit to less than 2 m (6').

.2 The flexible conduit shall be neatly installed parallel or perpendicular to building lines, and independently supported from the slab structure above.

.13 Conduit shall be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

.14 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

.15 Vertical raceways to be provided with insulated cable support bushings or other approved method of supporting the weight of the cable, where vertical runs exceed those of Table 21 of the Electrical Code.

2 PRODUCTS

2.1 Conduits

.1 Rigid hot dipped galvanized steel threaded conduit

.2 Electrical metallic tubing (EMT), galvanized: with steel set-screw couplings.

.3 Rigid PVC conduit.

.4 Flexible metal conduit and liquid-tight flexible metal conduit.

.5 Conduit shall be of sufficient size to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

.1 Contractor responsible for providing minimum size of conduit required for maximum 40% fill of conductors applicable to all types of cable installation (power, communications, etc).

2.2 Conduit Fastenings

.1 One-hole steel straps to secure surface conduits 50 mm (2") and smaller. Two-hole steel straps for conduits larger than 50 mm (2").

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Six mm dia threaded rods to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90□ bends are required for 25 mm (1") and larger conduits

.3 Raintight insulated throat steel compression connectors and couplings for EMT.

.4 Threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit.

.5 Raintight insulated throat steel connectors at all surface panelboards, switchboards and other electrical equipment in sprinklered areas for all conduit terminations.

2.4 Expansion Fittings

.1 Electrogalvanized steel with internal grounding for EMT suitable for 100mm linear conduit movement.

Standard of Acceptance
□ Cooper Crouse Hinds XJG-EMT

.2 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm (4") linear expansion.

.3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm
(3/4") deflection in all directions.

.4 Concrete type, water tight, corrosion resistant for conduit installations embedded in concrete

.5 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 Fish Cord

.1 Polypropylene

3 EXECUTION

3.1 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 Use electrical metallic tubing (EMT) except: in cast concrete, underground or where installed exposed within 2.0m (6'-6") of floor.

.4 Use rigid galvanized steel conduit where installed surface mounted within 2.0m (6'-6") of floor.

.5 Use rigid PVC conduit in slab on grade cast concrete and underground. Do not use PVC conduits in slabs above grade. All conduits shall be surface mounted to minimize risks of future damage when core drilling during future renovations. Where localized congestion or circumstances forces the use of conduits in the floor slabs, they shall be epoxy coated rigid galvanized steel.

.6 Provide PVC conduit with bonding conductor as per Table 16A of Ontario Electrical Safety Code.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment

.8 Use raintight connectors or hubs for terminating conduits at all surface or floor mounted panelboards, switchboards, and other equipment located in sprinklered areas or where at risk of exposure to dripping liquids.

.9 Install wiring in conduit unless otherwise specified.

.10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.11 Mechanically bend steel conduit over 19mm (3/4") dia.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 Install fish cord in empty conduits.

.14 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

.16 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy- coated conduit.

.17 Install junction boxes or cable anchor boxes wherever necessary for proper pulling or anchoring of cables. Install so as to be accessible after building is completed and set to

come within finished lines of building.

.18 Run green insulated bonding conductor in conduit, with minimum one bonding conductor per three ungrounded conductors.

.19 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints, as required.

.20 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. They shall be installed as close to building structure as possible such that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5m (5') clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

.7 Exposed conduit shall be painted to match adjacent surfaces.

3.3 Concealed Conduit

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS
26 05 35

1 GENERAL

1.1 Related Work

.1 Box connectors to Section 26 27 28.

1.2 References

.1 CSA C22.2 No. 18.

.2 CSA C22.1 Canadian Electrical Code, Part 1, Ontario Hydro Electrical Safety Code.

2 PRODUCTS

2.1 Outlet and Conduit Boxes - General

.1 Size boxes in accordance with CSA C22.1

.2 102 mm (4") square or larger outlet boxes as required for special devices

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Sheet Steel Outlet Boxes

.1 Hot dipped galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 38 mm (3" x 2" x 1½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 Masonry Boxes

.1 Hot dipped galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

.1 Hot dipped galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Floor Boxes

.1 Concrete tight hot dipped galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass or brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex single or receptacles. Minimum depth: 28 mm (1¼") for receptacles; 73 mm (3")

for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm (½") and 19 mm (¾") conduit. Minimum size: 73 mm (3") deep.

.3 Alternate boxes, as specified on Contract Drawings, are permitted. These boxes are to be installed per manufacturer's instructions and in compliance with the Electrical Safety Code.

2.6 Conduit Boxes

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle, outside building and where weatherproof boxes are required.

.2 Explosion proof boxes in areas indicated on drawings.

2.7 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm (1½") and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3 EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (¼") of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.

.6 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.7 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.

.8 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.

.9 Where 100 mm (4") square boxes are installed in exposed concrete or cinder block in finished areas, blocks will be cut under masonry division as instructed under this section. Openings shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of

plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

END OF SECTION

PROJECT CLOSE-OUT ELECTRICAL
26 08 19

1 GENERAL

1.1 Scope

.1 Provide documentation deliverables at completion of the Work.

1.2 Occupancy Permit

.1 Submit the reviewed final Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit.

1.3 Substantial Performance

.1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.

.2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.

.3 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.

.1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.

.4 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.4 Total Performance

.1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.

.1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

☐ Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.
Equipment start-up reports
(Interim).

☐ Building department inspection reports.

☐ ESA field inspection reports.

☐ Fire alarm verification certificate.

☐ Equipment and wiring identification completed

☐ Clean-up completed.

☐ Spare parts and replacement parts turned over to Owner; transmittal attached.

☐ Warranty certificates

☐ Operating and Maintenance Manuals, draft, submitted.

☐ As-built drawings submitted

☐ Training completed and attendance logs submitted.

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.

☐ Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicated here: ☐.

☐ As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here: ☐ Date of delivery: _____

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

END OF SECTION

WIRING DEVICES
26 27 26

1 GENERAL

1.1 Related Sections

.1 Section 26 05 01 - Electrical Basic Materials & Methods.

.2 Section 26 05 53 - Identification for Electrical Systems.

.3 Section 26 28 19 - Ground Fault Circuit Interrupters.

.4 Section 26 51 13 - Lighting

1.2 Submittals

.1 Submit shop drawings for each type and size of device.

1.3 Applicable Codes and Standards

.1 Latest version of CSA C22.2 No. 111-M1986 Switches.

.2 Latest version of CSA C22.2 No. 42-M1984 Receptacles.

1.4 Scope

.1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

2 PRODUCTS

2.1 **Nameplates**

.1 Wall mounted:
  .1 engraved laminated plastic to Section 26 05 53 Identification for Electrical Systems,
  .2 7 mm (¼”) high letters unless indicated otherwise.

.2 Receptacle mounted:
  .1 permanently printed on white polyester background,
  .2 7 mm (¼") high letters unless indicated otherwise,
  .3 UV resistant inks,
  .4 clear polyester over lamination,
  .5 pressure sensitive adhesive.

.3 Colours:
  .1 normal power: black lettering on white background,
  .2 emergency power: red lettering on a white background,

2.2 **Switches**

.1 Features:

.1 20 A, 120 V, general purpose AC type,

.2 higher ratings where indicated,

.3 CSA listed,

.4 fully rated for tungsten filament and fluorescent lamps, and for inductive loads,

.5 commercial grade

.6 silent operation,

.7 terminals rated for No. 10 AWG wire,

.8 suitable for back and side wiring,

.9 silver alloy contacts,

.10 single pole, double pole, three-way, four-way switches as indicated.

.2 Toggle colours:

.1 Normal power: Coordinate with Architect.

.2 Emergency power: Coordinate with Architect.

.3 Decora rocker colour: Coordinate with Architect.

.4 Switches of one manufacturer throughout project, unless accepted otherwise.

Standard of Acceptance

- Lutron
- Pass & Seymour (Legrand)
- Hubbell
- Bryant Electric
- Cooper-Eaton Wiring Devices (Arrow Hart)
- Leviton

.5 Switches controlling lights on 120 volt emergency power circuits: lighted handle, light to be on when load is off

.6 Pilot light switches: red pilot light to be on when the load is on

2.3 Occupancy Sensor

.1 Occupancy sensors shall be dual-technology with passive infrared and ultrasonic sensing mechanism.

.2 Occupancy sensors shall be ceiling-mounted.

.3 Sensor timeout should be programmable between 1 minute and 60 minutes.

.4 All occupancy sensors should be provided with a manual override switch. Location of override switch to be coordinated with Consultant and Owner prior to installation.

2.4 Vacancy Sensor

.1 Vacancy sensors shall be dual-technology with passive infrared and ultrasonic sensing mechanism.

.2 Sensor timeout should be programmable between 1 minute and 60 minutes.

.3 All vacancy sensors should be provided with a manual override switch. Location of override switch to be coordinated with Consultant and Owner prior to installation.

2.5 Dimming Switch

.1 Control switch to be capable of dimming within a Decora-style single switch unless digital system is used.

.2 Provide entire back-end infrastructure / components, including wiring, backboxes, power supplies, communication modules, mounting plates, etc, to create completely functional system for the zones identified in the Contract Drawings.

Standard of Acceptance
- Acuity nPODM (nLight-based)
- Lutron Quantum

2.6 Lighting Control System

.1 Provide all components as required to meet the operating parameters described in Section 26 51 12 – Lighting.

.2 System is to be comprised of the following components at a minimum, or as shown on Contract Drawings:

.1 Lighting control panel,

.2 Local dimmer switches (as required),

.3 Local occupancy sensors (as required),

.4 Local vacancy sensors (as required),

.5 Emergency power interface modules (as required),

.6 Fire alarm interface module (as required),

.7 Any interconnecting components, modules, wiring or devices to form a complete lighting control system to meet the requirements of Section 26 51 13.

.3 All lighting control devices are to be tied into new main lighting control system.

.4 Coordinate quantity and location of fire alarm control modules with Fire Alarm Vendor to operate lighting control system as intended and described in Section 26 51 13. Fire Alarm Vendor is responsible for installing, configuring and commissioning the related control modules in coordination with Lighting Control Supplier and Electrical Contractor.

.5 Provide interface module for new lighting control panel to be tied into building automation system via Ethernet connection.

2.7 Receptacles

.1 Decora style.

.2 With the following features:

.1 eight back wired entrances, four side wiring screws,

.2 suitable for no. 10 AWG for back and side wiring,

.3 break-off links for use as split receptacles,

.4 triple wipe contacts,

.5 riveted or integral ground contacts.

.3 Colour coded as follows:

.1 Normal power: Coordinate with Architect

.2 Emergency power: Coordinate with Architect

.4 One manufacturer throughout the project.

Standard of Acceptance

- Pass & Seymour (Legrand)
- Hubbell
- Bryant Electric
- Cooper-Eaton Wiring Devices (Arrow Hart)
- Leviton

2.8 Ground Fault Circuit Interrupters (GFCI's)

.1 CSA approved Type A.

.2 Complete with suitable outlet box.

.3 15A grounded duplex Decora receptacle type 5-15R.

.4 15A/20A grounded duplex Decora receptacle type 5-20R where indicated.

.5 Auto-monitoring (self-test), manual test feature and reset switch.

.6 Units to include current transformer and sensing mechanism.

.7 GFCI's in patient care areas: hospital grade.

.8 Unless noted otherwise, unit to trip at 6 mA.

.9 No power at device face if reversed wired.

.10 Colour coded as follows:

.1 Normal power: Coordinate with Architect

.2 Emergency power: Coordinate with Architect

2.9 Cover Plates

.1 Cover plates for all wall-mounted wiring devices to be Decora-type in all areas that are not considered service spaces, sized to conceal the junction box and service wiring.

.1 Colour / finish of cover plate is to be coordinated with Architect.

.2 Stainless steel cover plates to be provided for all wiring devices installed within service spaces.

3 EXECUTION

3.1 Identification

.1 Label receptacles with circuit identification using a lamacoid label with colour coding for normal, emergency and UPS source with label attached to the receptacle.

.2 Label pilot light switches:

.1 lamacoid label secured to the wall above the switch,

.2 engraved with the name of the load controlled,

.3 black lettering on white background.

3.2 Installation

.1 Switches

.1 Mount switches vertically so that the switch contacts are closed when the toggle is up or, in the case of Decora switches, when the top part of the rocker is depressed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Provide separate boxes where switches are supplied from different power systems (normal and emergency).

.4 Mount switches at heights specified in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.

.5 Verify the door swing and ensure easy access before installing switches.

.6 Switches installed adjacent to dimmers: provide switches that match appearance of dimmers.

.7 Pilot light switches: run a neutral conductor to the switch.

.8 Provide a neutral wire connection in every switch location.

.2 Receptacles

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Provide separate boxes where receptacles are supplied from different power systems (normal and emergency).

.3 Mount receptacles at heights specified in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.

.4 For each type of receptacle 20 ampere or larger, supply and hand to Owner two heavy duty caps.

.5 Connect receptacle grounding terminal to the outlet box with an insulated green bonding conductor.

.6 Verify exact position of service fittings to suit furniture layout.

.7 Do not mount receptacles directly on a column, unless column has been appropriately furred, to avoid breaking fire barrier.

.3 Cover Plates

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Ground fault circuit interrupters:

.1 Mount receptacles at height indicated in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise by Architect.

.2 Do not connect GFCI receptacles to provide protection to downstream receptacles, unless indicated otherwise.

.5 Outlets in Movable Partitions

.1 Co-ordinate installation of outlet boxes and conduits with the particular trade involved.

3.3 Testing

.1 Verify the operation of illuminated handles in switches.

.2 Verify the operation of lights on pilot light switches.

.3 Test each receptacle for correct polarity and ground continuity.

.4 Test the manual trip and reset functions of each GFCI.

.5 Verify lighting control system functionality in the presence of an Owner’s Representative.

3.4 Training

.1 Provide minimum one (1) 8-hour on-site training session for the Owner held by the Manufacturer to demonstrate the functionality and typical maintenance practices for the lighting control system.

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V
26 27 28

1 GENERAL

1.1 Applicable Codes and Standards

.1 Latest version of CSA C22.2 No.65 Wire Connectors.

.2 Latest version of CSA C22.2 No.188 Splicing Wire Connectors.

2 PRODUCTS

2.1 Materials

.1 Mechanical pressure type wire connectors:

.1 for copper conductors: current carrying parts of tin-plated aluminum,

Standard of Acceptance
- Burndy
- Ilsco
- Thomas & Betts

.2 Compression type pressure wire connectors:

.1 long barrel

.2 tin plated copper for copper conductors

Standard of Acceptance
- Burndy
- Ilsco
- Thomas & Betts

.3 Twist on wire connectors:

.1 for copper wire up to and including #6 AWG,

.2 "live" spring construction,

.3 corrosion resistant spring,

.4 square wire spring construction,

.5 polypropylene cap rated for 105°C

Standard of Acceptance
- T&B Marette
- Ideal
- 3M

.6 For damp, wet, outdoor and submersible locations: filled with silicone gel.

.4 Fixture type splicing connectors:

.1 current carrying parts of copper,

.2 sized to fit copper conductors 10 AWG or less,

.3 temperature rating of not less than 105°C

Standard of Acceptance
- Burndy
- Hubbell
- Thomas & Betts

3 EXECUTION

3.1 Installation

.1 Provide connectors in accordance with the manufacturer's recommendation for the size, quantity and type of wires.

.2 Install connectors in accordance with the manufacturer's recommendations.

.3 Remove insulation carefully from ends of conductors:

.1 where the conductor is damaged, remove the damaged portion and strip the insulation back further as necessary,

.2 where the conductor is too short, replace the conductor.

.4 Tighten screws of mechanical pressure type connectors in accordance with the manufacturer's recommendations. Installation to meet secureness tests in accordance with CSA C22.2 No.65.

.5 Install compression type connectors using the appropriate compression tool and die as recommended by the manufacturer. Make two crimps on each wire. Installation to meet secureness tests in accordance with CSA C22.2 No.65.

.6 Remove all traces of electrical joint compound after each connection has been made.

.7 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS
26 28 16

1 GENERAL

1.1 References

.1 CAN/CSA C22.2 No. 5.1. Moulded case circuit breakers.

1.2 General Requirements

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Nameplates shall be in accordance with Article "Equipment Identification".

.3 Include time-current characteristic curves for breakers with ampacity of 200 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.4 Work Included

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.5 Operation and Maintenance Data

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

1.6 Maintenance Materials

.1 Provide maintenance materials as required and as specified in Section 26 05 01 Electrical General Requirements.

1.7 Operating and Maintenance Instructions

.1 Provide operating and maintenance instructions as specified in Section 26 05 01 Electrical GeneralRequirements.

2 PRODUCTS

2.1 Breakers General

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 5 - 10 times current rating.

.4 Circuit breakers with interchangeable trips over 150 A.

.5 18,000 Amps (or to match existing) symmetrical interrupting rating at 208 volts

.6 35,000 Amps (or to match existing) symmetrical interrupting rating at 600 volts

2.2 Thermal Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 Solid State Trip Breakers

.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault and short circuit protection.

2.4 Features

.1 Include

.1 on-off locking device

.2 handle mechanism

.3 shunt trip, where shown

2.5 Enclosure

.1 Mount individually mounted breakers in CEMA 3 enclosure.

3 EXECUTION

3.1 Installation

.1 Install circuit breakers as indicated.

.2 For breakers that have a shunt trip requirement, the power supply for the shunt trip is to be fed from the circuit breaker within the same panelboard indicated for that purpose. Contractor is to wire the shunt trip power source from the load side of the breaker, as per the manufacturer's instructions.

END OF SECTION

LIGHTING
26 51 13

1 GENERAL

1.1 General Requirements

.1 Conform with the requirements of Section 26 05 01 Electrical General Requirements.

1.2 Work Included

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.3 Related Documents

.1 26 27 26 Wiring Devices

1.4 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 26 05 01 Electrical General Requirements - Shop Drawings and Product Data.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.

.3 Photometric data to include:

.1 Total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.

1.5 Requirements

.1 Luminaires shall not be delivered to building or stored therein until dry and protected space is available for proper storage of luminaires.

.2 Submit samples of luminaires which are not catalogue items for approval. Additional luminaires shall not be manufactured until sample has been approved. Each approved sample shall be retained on job site until final completion of project. Luminaires which do not match quality and workmanship of standard sample will be rejected.

.3 Finishes of luminaires, as specified in the "Luminaire List" must be maintained. Where the description of the luminaire directs a "colour/ finish to suit Architect" it is to be understood that during construction the final colour/finish will be selected. The Architect must be permitted to make their choice from a standard colour/finish range but the selected colour will apply to all of the particular type of luminaire unless otherwise specified.

.4 "Allowances" when shown, are in Canadian dollars and cover the cost of the lighting luminaires and lamps. Allowances do not include applicable taxes, delivery to the site, handling, installation, overhead or profit.

1.6 Substitutions

.1 Luminaires included under this Section are specified by approved manufacturer and type. Furnish equipment, as specified, unless substitutions are mutually agreed upon, as follows:

.1 During the construction period, no substitutions shall be considered unless compelling reasons are given such as inability to meet delivery schedule. This reason shall not be acceptable if delay is caused by Contractor's failure to order luminaires in accordance with the schedule. In such cases, it is the Contractor's responsibility to provide luminaires as specified without delay to the project and without additional cost to the Owner.

.2 Substitutions shall be named, samples, catalogue cuts and complete photometric reports submitted, and cost savings documented. Submit a written request for proposed luminaires to be substituted to Consultant at least two weeks before the end of the bid period. Make the request an alternate, separate proposal, accompanied by complete descriptive and technical data. Indicate addition or deduction from the base bid. Substitutions proposed less than two weeks before the end of the bid period, or not including proper documentation shall not be considered. Consultant shall accept or reject proposed substitutions.

.3 Where proposed substitutions alter functional or visual design, or change the space requirements or mounting details indicated here or on the drawings, detail such changes in the proposal and include costs for revised design and construction for trades involved.

.4 Reimburse Consultant and his/her consultants for costs of evaluating proposed substitutions, after the bid period, whether or not such substitutions are accepted.

2 PRODUCTS

2.1 General

.1 Similar luminaires shall be products of same manufacturer.

.2 Luminaires shall be suitable for individual or continuous mounting.

.3 Supply recessed luminaires, where installed in plaster or in acoustic ceilings, complete with plaster trim frame or ring and mounting brackets.

.4 Luminaires shall be completely assembled in factory and shall be delivered to building in cartons or in palletized form, as directed.

.5 Lighting control devices are outlined in Section 26 27 26 Wiring Devices.

2.2 Lamps

.1 Light Emitting Diodes (LED)

.1 Available in 2700K, 3000K, 3500K and 4000K correlated colour temperature (CCT) packages. CCT tolerances to remain within a 3-step MacAdam ellipse and to maintain a CRI of ≥80, and an $R_9 > 50$.

.2 Colour temperature, CRI and lumen output for each luminaire per luminaire schedule. Comply with IESNA LM-79 testing procedures.

.3 Maximum temperature at the base of the “LED cap” mounted to the substrate to be controlled to ensure full lamp life.

.4 Minimum lumen maintenance of L_{70} @ 100,000 hours. Comply with IESNA LM-80 and LM-21 testing procedures.

.5 LED’s of the same type to be from the same manufacturing batch.

.6 Capable of continuous dimming, flicker and noise free, from 10-100% lumen output.

.7 Provide certified test results for each type of LED used on the project.

.8 LED to be certified to IES TM-21-11 rating for greater than 75 000 hours lifetime.

.9 Warranty: 10 years

Standard of Acceptance
- Cree
- Lumileds
- Nichia
- Osram
- GE
- Samsung
- Bridgelux

2.3 Drivers

.1 Operable from 50/60 Hz input source of 120V through 277V or 347V through 480V with sustained variations of ± 10% (voltage) with no damage to the driver.

.1 Where driver is required to be 347V – 480V rated due to existing electrical connections, a mini- step down transformer is to be provided exterior to the fixture for each driver.

.2 Input power factor greater than 0.90 from 20% to 100% rated load.

.3 Input current Total Harmonic Distortion (THD) less than 10% 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 ripping 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 LEDs based on IEEE/ANSI C62.41.2 surge characteristics:

.1 For interior applications: common-mode and differential mode surge protection of 2.5 kV (100 kHz, 30 Ohm ring wave),

.2 For exterior applications: common-mode and differential mode surge protection of 3 kV (1.2/50 µs, 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, and is to be 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 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, 0-10V for 1% typical (unless indicated otherwise).

.15 Class A sound rating.

.16 Rated for UL damp and dry locations.

.17 For downlights: compact enclosure with integral studs allowing the driver to be mounted on the outside of the luminaire or remotely on a junction box without the need for an additional enclosure.

.18 For linear luminaires: slim profile with height ≤ 25 mm (1”) and width ≤ 30 mm (1.2”).

.19 Integral colour-coded connectors.

.20 Free of any polychlorinated biphenyls (PCBs).

.21 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, Light Emitting Diodes (LED) equipment for use in lighting applications

.22 Comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, for non-consumer equipment.

.23 RoHS compliant.

.24 Warranty: 10 years

Standard of Acceptance
- Advance
- Litetech
- Universal
- VLM (Italy)
- Lumi-Drives (UK)
- Osram
- AC Electronics
- EldoLED

2.4 Exit Signs

.1 Exit signs to CSA 22.2 No. 141 Emergency Lighting Equipment.

.2 Internally illuminated by white L.E.D. sources.

.3 Single or double face as shown.

.4 Each face to show a green “running man” pictogram.

.5 With directional arrows as shown.

.6 Directional arrows to be white.

.7 Visibility of signs to ISO 3864-1 Graphical Symbols – Safety Colours and Safety Signs – Part 1: Design Principles for Safety Signs in Workplaces and Public Areas.

.8 Dimensions of signs, pictograms and symbols to ISO 7010 Graphical Symbols – Safety Colours and Safety Signs – Safety Signs Used in Workplaces and Public Areas.

.9 With 12 Volt two wire DC emergency power input.

.10 Contain integral emergency supply battery for minimum 120-minute runtime, unless otherwise noted.

.11 Universal mounting option; final mounting configuration to be confirmed with Architect and Engineer prior to procurement.

3 EXECUTION

3.1 Installation

.1 Locate and install luminaires as indicated.

.2 Emergency fixture indicated in drawing shall connect to emergency circuits.

.1 Where emergency circuit is not available or indicated on Drawings, emergency fixture is to be provided with integral battery backup for a minimum of 90-minute runtime unless otherwise noted.

.3 Locate hangers on tile centres or intersections. Mount recessed troffers and surface mounted luminaires in or on full tiles.

.4 Verify the quantity of luminaires before placing orders.

.5 Verify ceiling types with the latest revised Architectural Drawings and order luminaires to suit the correct ceiling.

.6 Check lighting luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to luminaires or hanging arrangement without expense to Owners. Give notification at the time of shop drawings and before construction if the decision on necessary changes is required.

.7 Co-operate with other trades to ensure proper installation of lighting luminaires.

.8 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.

.9 Mount luminaires perfectly level or plumb. Luminaires shall fit tightly to the ceiling without showing a space or light leak between frame and ceiling.

.10 Take down any improperly installed luminaires and re-install without expense to Owner.

.11 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on the ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.

.12 Attach boxes or hickies directly to poured concrete with 6mm (¼") minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8mm (5/16") minimum bolts through precast slabs, welded to 100mm x 100mm (4" x 4") minimum, 3.5mm (10 gauge) plate above slabs.

.13 Do not mount luminaires above pipes, ducts or equipment. In the event of unavoidably tight locations, provide hangers to clear obstructions. Check layouts of other trades on the job and plan co- operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown

.14 All luminaires mounted in or on suspended ceilings shall be supported independently of ceiling by means of chains.

.15 Provide continuous 12mm x 38mm (½" x 1½") channel above the ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6mm (¼") minimum diameter studs with minimum 1220mm (4'- 0") on centre.

.16 Luminaires installed in or on "T" bar ceilings shall be equipped with safety chains anchored in an approved manner to the floor slab or roof structure above. Troffer luminaires shall have two chains, each supporting two corners of the luminaire. Chain shall be #10 Tensile jack chain, installed as noted below.

.17 The chain shall be No. 10 Tensile jack chain, bright zinc coated, with a strength of 180 kg (400 lbs.) where luminaires are indicated to be chain hung. Attachments shall be made using a No. 10 "S" hook. Caddy fasteners may be used where applicable. "S" hooks must be closed after installation.

.18 Industrial luminaires where suspended shall be 12mm (½") conduit hangers and ARB ball aligners.Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas and electrical rooms.

3.2 Lighting Luminaires

.1 Provide lighting luminaires exactly as shown and as specified in the following schedule. Luminaires shall be complete with necessary accessories and lamps at time of acceptance.

.2 All luminaires shall be ULC or CSA certified.

.3 Luminaires shall be Energy Star-rated or Design Lights Consortium (DLC) listed.

3.3 Valance Lighting

.1 Provide LED strip lighting underneath upper cabinets and areas where shown. Installation of lighting is to be coordinated in the field with Architectural design and millwork contractor.

.2 Provide separate switch adjacent to the cabinet to operate the valance lighting.

3.4 Lab Lighting Control

.1 Each lab to have their own local controls with on/off, dimming and occupancy sensors, as shown, for the zones indicated.

.2 Emergency fixtures to override all dimming during normal power loss.

.3 Lighting controls to be integrated with fire alarm system such that during a fire alarm situation all emergency fixtures at minimum are to be restored to full brightness.

.4 Provide local 0-10 V, 1% dimming switch with manual on/off control within each lighting zone area for local control.

3.5 Exit Signs

.1 Connect Exit signs to a dedicated 120 Volt circuit and provide a lock on the device on the branch circuit breaker.

.2 Connect the DC circuit to the emergency power input.

.3 In addition to the Exit signs shown, provide a quantity of three (3) exit signs including circuit breakers, lock on devices, junction boxes and wiring from a 120 Volt power source and DC wiring from the remote battery source. Signs to be installed as required by the local building authority. Turn over any signs, not required to be installed, to the Owner as spares.

.4 LED exit sign finish colour to be white as base option. Contractor to coordinate final finish with Architect prior to procurement. Application of a custom colour during shop drawing review should be carried at no additional cost to the Owner.

3.6 Luminaire List

.1 Luminaires to be procured as specified on the lighting schedule below.

.2 All mounting heights and exact location of luminaires are to be coordinated with Architectural drawings.

TYPE	DESCRIPTION	LUMINAIRE DESCRIPTION	REMARKS
LED LIGHTING			
A	RECESSED LED (T-BAR Ceiling)	MANUFACTURER: VISIONEERING MODEL: LRTH LED Recessed Type H ORDERING INFO: LRTH 2X4-LED-8-35K-050L-UNV Recessed 2’x4’ light fixture complete with 3500K 80+CRI 5000 lumen LED, 0-10V dimming driver, round frosted acrylic lens, and universal voltage input. Where indicated as 'EM', fixture is to be supplied with emergency circuit option.	Exact finish and mounting type to be confirmed by architect.
A1	RECESSED LED (Drywall Ceiling)	MANUFACTURER: VISIONEERING MODEL: LRTH LED Recessed Type H ORDERING INFO: LRTH 2X4-LED-8-35K-050L-UNV Recessed 2’x4’ light fixture complete with 3500K 80+CRI 5000 lumen LED, 0-10V dimming driver, round frosted acrylic lens, and universal voltage input. Where indicated as 'EM', fixture is to be supplied with emergency circuit option.	Exact finish and mounting type to be confirmed by architect.

A2	RECESSED LED (Drywall Ceiling)	MANUFACTURER: VISIONEERING MODEL: LRTH LED Recessed Type H ORDERING INFO: LRTH 2X2-LED-8-35K-050L-UNV Recessed 2'x2' light fixture complete with 3500K 80+CRI 5000 lumen LED, 0-10V dimming driver, round frosted acrylic lens, and universal voltage input. Where indicated as 'EM', fixture is to be supplied with emergency circuit option.	Exact finish and mounting type to be confirmed by architect.
B	DIRECT RECESSED (T-BAR Ceiling)	MANUFACTURER: AXIS LIGHTING MODEL: Beam 4 LED Recessed Mount ORDERING INFO:BBRLED-500-80-35-FL-4-W-UNV-DP-1-X Recessed 4' linear light fixture complete with 3500K 80+ CRI 500+ lumens/ft LED, 0-10V dimming driver, single circuit, and universal voltage input. Where indicated as 'EM', fixture is to be supplied with emergency circuit option.	Exact finish and mounting to be confirmed by architect.
B-12	DIRECT RECESSED (T-BAR)	MANUFACTURER: AXIS LIGHTING MODEL: Beam 4 LED Recessed Mount ORDERING INFO:BBRLED-500-80-35-FL-12-W-UNV-DP-1-X MANUFACTURER: METALUMEN MODEL: Rail 4 RM4D (Formerly Grande) ORDERING INFO: RM4D-1L35K-4-MB-L3-T-UNV Recessed 12' linear light fixture complete with 3500K 80+ CRI 500+ lumens/ft LED, 0-10V dimming driver, single circuit, and universal voltage input. Where indicated as 'EM', fixture is to be supplied with emergency circuit option.	Exact finish and mounting to be confirmed by architect.

C-4	SUSPENDED LINEAR (D/I)	MANUFACTURER: AXIS LIGHTING MODEL: Twin Beam 4 SurroundLite ORDERING INFO: TB4DILED-400-1000-90-40-SO-SO-4-X-UNV-DP-1- CA36 MANUFACTURER: MARK ARCHITECTURAL LIGHTING MODEL: Slot 4 LED-Direct/Indirect Pendant (Non-Tunable) ORDERING INFO: S4LID-4FT-MSL4-90CRI-40K-1000LMF-I90CRI- I40K-I600LMF-MIN1-SCT-MVOLT-X-NLIGHT- F2/72A-X MANUFACTURER: LUMENWERX MODEL: VIA 3 LED-Direct/Indirect Pendant (Non-Tunable) ORDERING INFO: VIA3PDI-HLO-WIO-LED-90CRI-1000-500-40-4FT- UNV-D1-1 Suspended 4’ linear light fixture complete with 4000K 90 CRI 1000 lumens/ft DIRECT and 400+ lumens/ft INDIRECT LED, 0-10V dimming driver, diffuse lens, single circuit, and universal voltage input. Lighting is to be provided complete with dimming control system. Contractor to coordinate run lengths with supplier and contract drawings prior to procurement. Where indicated as 'EM', fixture is to be supplied with emergency circuit option.	Exact location, finishes, canopy types and mounting height to be confirmed by architect. Either option is considered suitable for this application.
U	LINEAR UTILITY LIGHT	MANUFACTURER: VISCOR MODEL: LCOM ORDERING INFO: LCOM48-LED840K030LUNV-P77 4’-0” linear LED fixture complete with 3500K 80+CRI 3000 lumen LED, universal voltage input, and round P77 lens.	Exact finish and mounting to be coordinated with architectural drawings.
D	DOWNLIGHT	MANUFACTURER: LIGHTOLIER MODEL: LYTEPROFILE 4” ORDERING INFO (FRAME) : 4-S-N-UNV ORDERING INFO (ENGINE/TRIM) : P4S-DL-15-CL-FINISH(TBC) – Z10 – U- 4” Downlight LED fixture complete with 3500K 80+CRI 3000 lumen LED, universal voltage input, and round P77 lens.	Exact finish and mounting to be coordinated with architectural drawings.

X01	EXIT SIGN	Edge lit exit sign with RECESSED trim plate constructed of brushed aluminum. With three styles of illuminated panels: -without arrow -with arrow to the right -with arrow to the left In unfinished areas install surface mounted with mounting bracket suitable for ceiling, wall or end mounting. Voltage: 120 Standard of Acceptance: Beghelli "GuidaRM Series" Emergi-Lite "EDE Series" Lumacell "LDE Series"	Connect to emergency circuit. Exact mounting height to be coordinated with architectural drawings. Exit sign to be provided with universal mount. Where exit sign type is not shown on Contract Drawings, this sign type shall be applicable.

3.7 Commissioning

.1 Commissioning of lighting control systems to be completed with user input from the Owner and
Consultant after occupancy of the space at no additional cost.

.2 Contractor to provide a photometric survey of each room within the scope of the project in its final condition for review by the Owner and Consultant. Contractor is to provide a minimum of fifty (50) light level measurements throughout the project area after daylight hours. Location of measurements to be dictated by Consultant.

.3 Contractor shall record these results on a plan drawing with the following information: date, time, temperature, model of light meter, calibration certificate of light meter, height of illuminance measurement (tread level, desk height, etc).

.4 Submit light level measurements with operations and maintenance manual as part of close out documentation package.

.5 Contractor to coordinate with fire alarm vendor for verification of fire alarm interface to lighting control system.

END OF SECTION

COMMUNICATION SERVICES
27 05 13

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 To be read in conjunction with associated electrical and communication specification sections.

1.2 Related Documents

.1 Drawings and general provisions of the Contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 26 Grounding and Bonding for Communications Systems

.3 27 05 29 Hangers and Supports for Communication Systems

.4 27 05 33 Conduits and Back Boxes for Communication Systems

.5 27 05 36 Cable Trays for Communication Systems

.6 27 05 53 Identification for Communication Systems

.7 27 15 55 Testing for Communication Services

.8 27 11 23 Communications Cable Management and Ladder Rack

.9 27 15 01 19 Data Communications Horizontal Cabling

.10 27 15 43 Communication Faceplates and Connectors

.11 27 16 19 Communication Patch Cords and Cross Connect Wire

1.3 Quality Assurance

.1 The Contractor shall be certified, along with all technicians who should be properly trained by the manufacturer of a proposed cabling solution, with proof of certification readily available upon request.

.2 Only new products listed in this document may be used unless otherwise submitted for approval.

.3 The bidder shall demonstrate proven expertise in the implementation of network cabling. Expertise can be illustrated through the inclusion of details of at least two projects involving the design and installation of a minimum 300MHz balanced unshielded twisted pair, Category 6 copper cable and OS2 single-mode fibre backbone cabling systems within the past two years. Names and contact information for each of the two projects shall be included in their bid response.

1.4 Scope

.1 The Contractor shall be responsible for the complete supply and installation of the following where required:

.1 Communication basket cabling trays, supporting and installation hardware.

.2 Horizontal CAT6 Cabling including all faceplates, MDVO jacks, patch cords, patch panels etc.

.3 Cabinets and data racks along with associated hardware.

.4 Grounding of cable trays and data racks/cabinets.

.5 Copper and fibre backbone cabling including all components for a complete end to end system.

.6 Testing of all horizontal voice, data, and backbone fibre cabling.

.2 Contractor to make all necessary preparations, allowances and precautions to comply with the labour requirements for the job site to ensure that there will not be any disruption of work arising from the successful bidders work or workers.

1.5 General Stipulations

.1 The Contractor shall furnish all labour, materials, tools and other equipment necessary to provide a complete horizontal and backbone (copper and fibre) cabling system, as required per the Contract Drawings.

.2 The Contractor shall be responsible for the completion of all work included in the Contract and shall employ certified, skilled technicians as necessary to satisfy all work and trades.

.3 The Contractor shall carefully review all drawings (architectural, mechanical, electrical and communications) associated with the project and carry out the work so as not to delay or interfere with other trades.

.4 The Contractor must comply with all requirements of the Occupational Health & Safety Act.

.5 The Contractor shall provide all necessary permits to carry out their work.

.6 Local codes shall take precedence over the drawings and specifications, except where the Contract Documents are more stringent, then the Contract Documents shall apply.

.7 When the installation of the cabling system is completed and ready for acceptance the IT department contact shall be present for testing of the complete system.

.8 All testing and retesting shall be done at the Contractor’s expense.

.9 Contractor to provide cable test results 10 (ten) business days prior to the cutover to the IT contact for review.

.10 A DRAFT network drawing, detailing physical port locations, quantities and identifications must be provided ahead of time for I&ITS Network Engineering to configure network equipment. This length of time is variable and is represented as a function of the number of data drops. Each drop requires approximately 7 minutes of configuration time, hence a network map for a building with 500 data drops must be provided at least 8 business days prior to commissioning network equipment: 500 drops x 7 minutes per drop = 3,500 minutes = 58.33 hours; 58.33 / 7.25 working hours per day =~ 8.04 days.

.11 Contractor to provide a finalized network drawing reflecting the cable tray routing and all data drop labels. A network drawing is similar to, but less complex than, an as-built drawing. Its sole purpose is to depict the physical locations of each network wall jack and its associated label on a floor plan.

.12 All network drawings and printing of drawings for the IT contact shall be done at the Contractor’s expense.

.13 The Project Manager and lead technician that start the project must remain on the project until

its completion.

1.6 Fire Stopping

.1 The Contractor shall seal all openings, new and/or old, they have utilized in floors, ceilings and partitions after all cabling has been completed. The fire stopping system and materials used shall comply with all applicable codes and conform to the acceptable testing methods and current standards in Canada, including, but not limited to, ULCS115 and CAN/ULC-S101. The acceptability by ULC and by local authorities having jurisdiction, should be confirmed by the Contractor to ensure that the test procedures were performed to ULC-S115 and CAN/ULC-S101.

.2 The non-permanent intumescent and systems used for sealing the openings shall have a fire rating equal to or greater than the fire rating of the floor/wall/partition assemblies being penetrated. The Contractor shall be responsible for confirming the fire rating of the different assemblies to be penetrated with the UTM designate and for ensuring the use of the proper fire proofing methods accordingly.

.3 Provide a non-permanent intumescent or hybrid fire stop system to cap all empty conduit ends, ducts, sleeves and slots, meeting or exceeding the requirements of 1.6.1.

.4 Provide a non-permanent intumescent or hybrid fire stop system around all cabling to seal the conduit, cable tray, ducts, sleeves and slot openings, re-sealable with minimal risk of damage to cables, meeting or exceeding the requirements of 1.6.1

.5 A non-permanent intumescent of hybrid fire stop system will be used, as per 1.6.3-1.6.4 even when conduits, ducts, sleeves or slots are filled to maximum capacity.

.6 Firestopping materials/systems used to fill voids in floors having openings greater than 100 mm in diameter, and which are accessible to the public, shall support floor design loading

.7 The Contractor shall furnish all labour, materials, tools and other equipment necessary to provide a complete fire stopping system

.8 The Contractor shall provide data sheets and applicable documentation for the fire stopping systems to be used and to demonstrate that the systems meets or exceeds the requirements of 1.6.1 & 1.6.2 prior to supply, installation and/or construction.

1.7 Schedule of Work

.1 The Contractor shall submit a schedule of work to be approved by the IT contact. The schedule shall clearly indicate the proposed order in which the various activities will be undertaken and the estimated time required for the completion of the various activities.

.2 The schedule of work may be revised periodically during the course of the project and must be approved by the IT contact.

1.8 Clean-Up

.1 The working space, telecommunications rooms and office spaces must be swept and free of unused cables, cable clippings, cardboard boxes or any other debris produced by the Contractor, on a daily basis, by the end of each day, or as needed during the course of the day. The Contractor is responsible for removing all trash to outside garbage containers at least once a day. The Contractor shall provide a complete clean-up of the rooms at the end of the project or MAC work activity.

.2 Workstation outlet location areas shall be cleaned on an on-going basis each time the Contractor completes any MAC work activity in the area.

.3 Costs associated for keeping the areas clean are the responsibility of the Contractor.

.4 Cleanliness of the site to be governed by the General Contractor/Construction Manager who may, after proper notice, back charge the Contractor for site clean-up.

1.9 Delivery and Storage

.1 Delivery and receipt of project materials shall be the sole responsibility of the Contractor to receive, move, secure and store all equipment and material. All delivery costs are to be included in the Contractor's proposal.

.2 All cable to be used in the project shall be stored according to manufacturer's recommendations. In addition, all cable must be stored in a protected area. If cable is stored outside, it must be covered with opaque plastic or canvas for protection from the elements, with adequate ventilation to prevent condensation. If air temperature at the cable storage location will be below 4.4 °C (40 °F), the cable shall be moved to a heated location [minimum 10 °C (50 °F)]. If necessary, cable shall be stored off-site at the Contractor's expense.

.3 The Contractor is allowed one (1) standard size job box on the site during construction. All tools, material and the job box are the sole responsibility of the Contractor. The Contractor is responsible for the complete storage, handling, moving, delivery and installation of all materials used in the performance of the work.

1.10 Project / Site Condition

.1 All bidders to arrange to obtain all necessary or referenced drawings and documents.

.2 The Contractor is responsible for seeking clarification with the UTM IT contact on how to address site and technical issues that may arise due to unforeseen difficulties. The Contractor is not to operate under assumptions and make design changes without prior approval of the IT contact. Whenever necessary, clarification must be sought every time unpredictable difficulties arise, from start to completion of a project.

.3 No claim for additional payment to be made for extra material or work made necessary by circumstances encountered due to conditions which were made visible upon, or reasonably inferable from thorough examination and review of all associated project documents, drawings and systems, prior to the submission of the response.

.4 No claim for additional payment to be made for extra material or work made necessary by circumstances encountered due to conditions which were made visible upon visit to premises. The Contractor must be abundantly experienced to infer material and workmanship required to carry out work performed both within visible and obstructed, hidden and underground locations. Such assessment is to be performed prior to the submission of the response

.5 During the implementation phase of a project, the Contractor is not to deviate, willingly or due to misunderstanding of documentation, from the specifications, diagrams and project documents provided by the IT contact. Doing so will require immediate corrective action by the Contractor and additional costs incurred in order to match the implementation with the design and specifications of the project will be done without hesitation at the Contractor's expenses.

.6 The cable routing diagrams only depict the cable routing and cable connectivity requirements. They are not installation drawings. Make all necessary allowances in the bid price to achieve the intent of the drawings.

1.11 Cutting and Patching

.1 Complete all cutting and patching required for the installation of the infrastructure.

.2 In existing work and work already finished, cutting, patching and painting will be required by the Contractor.

.3 Be aware of fire rated partitions and return all services to the condition encountered before start of the work.

1.12 Site Responsibilities

.1 All pull strings present at the beginning of the installation must be returned or replaced to the initial state at the end of the communications cabling installation.

.2 Do all cutting and patching required for the installation of the infrastructure.

.3 The client is not responsible or liable for any missing material and/or tools belonging to the Contractor.

.4 The Contractor is responsible for the removal and re-installation of all ceiling/floor tiles in the areas affected by its work. This is to be completed on a daily basis for the areas affected.

.5 Any damage to ceiling tiles during the completion of any work outlined in this document is the responsibility of the Contractor. Damage includes breaking, chipping or smudging. The decision with respect to any damage will be made by the General Contractor, Project Manager and the client.

.6 The Contractor is responsible for the storage and protection of the floor/ceiling tiles that are removed for cable installation.

.7 Cabling that is not terminated on both ends, must not, under any circumstances, be abandoned in place. At the completion of work, the Contractor is responsible for end-toend removal of dead and unterminated cables from existing conduits, raceways, fittings, cable trays, wiring troughs and any other apparatus used to protect and route cables, i.e. from 8P8C receptacles (a.k.a. RJ45 jacks) to the cable's termination point (usually a patch panel or network switch). Great care should be taken during the removal process so as to protect the existing live cables from damage.

1.13 Terms and Conditions

.1 All terms and conditions of the specifications, bid documents and accompanying drawings to be strictly adhered to by the Contractor, unless otherwise noted.

.2 Any inability to comply with these requirements must be stated in writing, in detail with the response submission. Otherwise, it will be understood that the Contractor is bound to the compliance with the stated terms and conditions.

.3 Contractor to comply with the G.C. construction and installation schedule.

.4 Do not assign or sub-Contract any work without prior written consent from the IT department and or communication consultant.

.5 Perform the complete installation in accordance with the latest editions of the Ontario and National Building Codes along with any other governing authorities of competent jurisdiction.

1.14 Coordination

.1 Coordinate telecommunications work with that of the other trades.

.2 Contractor to review any interference between general construction, telecommunications, architectural, mechanical, electrical, structural, and other specialty trades involved and bring it to the attention of the G.C.

1.15 Equipment and Identification

.1 All telecommunication equipment such as cabinets, racks and similar items shall be identified with labels which, ideally, should not exceed 8cm in length and 4cm in height.

.2 Coordinate telecommunications work with that of the other trades.

1.16 Warranty

.1 Contractor shall warrant the materials and workmanship used in the installation of this project. Components must be covered by a manufacturer's warranty against defects in material and workmanship for a period of at least 25 years from the date test results are submitted to the manufacturer and approved by UTM.

.2 All cabling system will meet or exceed the UTP channel transmission requirements specified by ANSI/TIA 568-D, Category 6.

.3 Contractor shall provide all material and labour to make any deficiencies due to faulty materials or workmanship which become apparent within a one-year period.

.4 All terminated horizontal cabling runs shall be 100% tested for defects in installation. Cabling system performance under installed conditions should comply to the requirements found in the TIA/EIA-568- C series of standards. All pairs in each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed cable runs.

.5 The communications Contractor shall submit the test results for the project to the IT contact 10 (ten) business days prior to the cutover, as indicated in 1.5.9.

.6 Upon completion of the testing by the Contractor for any MAC work, the Contractor shall submit to the IT contact the network drawing, including cable ID numbers related to the cabling completed for the project, 10 (ten) business days prior to the cutover, as indicated in 1.5.10.

.7 Failure to provide test results upon request will require the Contractor to retest all horizontal and or backbone cabling related to the project and any MAC work with no cost to the client.

1.17 Submissions

.1 The Contractor shall provide product data and shop drawings for all materials proposed for installation under this Contract. The product data and shop drawings shall be submitted to the IT contact for approval before such equipment is purchased and or delivered to the site.

.2 Review all aspects of the specifications and drawings and identify any and all issues for inclusion in the Contract Documents examination report.

.3 This section contains the definitions, acronyms and abbreviations that have special technical meaning or are unique to the technical content of this document

1.18 Standards

.1 The design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. The following are used as guidelines.

.1 Spaces and Pathways

TIA-569-B– Commercial Building Standard for Telecommunications Pathways and Spaces.

.2 Grounding

ANSI-J-STD-607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.3 Cabling Systems

ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises.

ANSI/TIA 568-C.1 Commercial Building Telecommunications Cabling Standard.

ANSI/TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

ANSI/TIA 568-C.3 Optical Fibre Cabling Components Standard.

.4 Cabling Administration

TIA/EIA-606-B – Administration Standard for Commercial Telecommunications Infrastructure

.5 Networking

IEEE Standard 802.3an (2006) – 10GBASE-T

.6 Design

BICSI Telecommunications Distribution Methods Manual (TDMM) – 13th edition.

.7 Installation

BICSI Information Transport Systems Installation Manual (ITSIMM) – 6th edition.

1.19 Definitions

.1 This section contains the definitions, acronyms and abbreviations that have special technical meaning or are unique to the technical content of this document.

.2 Above Finished Floor (AFF) - Standard mounting height (e.g.12-inch AFF) for a device using the centre line of the device as the measuring point.

.3 Backbone - A facility (e.g. pathway, cable or conductors) between the telecommunications room and the main telephone room.

.4 Bonding - The permanent joining of metallic parts to form an electrically conductive patch that will assure electrically continuity and the capacity to conduct safely any current likely to be imposed on it.

.5 Cable - An assembly of one or more conductors or optical fibres within a sheath, constructed so as to permit use of conductors singly or in groups.

.6 Entrance Room - A space in which the joining of inter or intra-building telecommunications backbone facilities takes place. An entrance room may also serve as the equipment room

.7 Horizontal Cabling - Portion of the cabling system that extends from the work area outlet, through the cabling in the wall/ceiling/floor and then to the patch panel in the telecommunications room. The system also includes the patch cords at the work area outlet, and patch cords in the telecommunications room.

.8 Intra-building Backbone - A backbone network providing communications within the building.

.9 Inter-building Backbone - A backbone network providing communications for more than one building.

.10 Patch Panel - A cross connect system of connectors that can be mated together to facilitates administration of a cabling system.

.11 Pathway - A facility for the placement of telecommunication cabling.

.12 Patch Cord - A length of cable (CAT6 or fibre) with connectors on each end to be used to join telecommunications circuits/links at the cross-connects.

.13 Telecommunications Room (TR) - An ample space in which the end of horizontal cabling is terminated in data racks. It connects to another TR or to the MTR for intrabuilding data and voice communication. The facility must be clean, dust-free and include proper air handling to regulate temperature and moisture in order to prevent the lifespan reduction of the equipment.

.14 Main Telecommunications Room (MTR) - An ample space in which the end of horizontal and backbone cabling is terminated in data racks. It is also a TR and is usually the node assigned for inter-building data and voice communication. The facility must be clean, dust-free and include proper air handling to regulate temperature and moisture in order to prevent the lifespan reduction of the equipment.

.15 Telecommunications Grounding Busbar (TGB) - A common point of connection for the telecommunications system and bonding to ground. It is located in the telecommunications room.

.16 Telecommunications Main Grounding Busbar (TMGB) - A common point of connection for the telecommunications system and bonding to ground. It is located in the main telecommunications room.

.17 Wireless Access Point (WAP) - The central or control point in a wireless cell that acts as a link for data traffic to and from the wireless devices in the cell.

1.20 Acronyms and Abbreviations

ACR Attenuation-to Crosstalk Ratio

ANSI American National Standards Institute

AWG American Wire Gauge

BC Building Conductor

BICSI Building Industry Consulting Service International

BTU	British Thermal Unit
CATV	Community Antenna Television (cable television)
CCTV	Closed Circuit Television
CSA	Canadian Standards Association
CT	Cable Tray
dB	Decibel
DSL	Digital Subscriber Line
DSU	Digital Service Unit
EMT	Electrical Metallic Tubing
EP	Entrance Point
FOTP	Fibre Optic Test Procedure
Ga	Gauge
Gb	Gigabit
HC	Horizontal Cross-connect
HVAC	Heating, ventilating and air conditioning
Hz	Hertz
IC	Intermediate cross-connect
LAN	Local Area Network
MTR	Main Telecommunications Room
NIC	Network Interface Card
OSP	Outside Plant
OTDR	Optical Time Domain Reflectometer
PB	Pull Box
PE	Polyethylene RF Radio Frequency
RFI	Radio Frequency Interference
RMC	Rigid Metal Conduit
SM	Single-mode
TBB	Telecommunications Bonding Backbone

TBBIBC Telecommunications Bonding Backbone Interconnecting Bonding Connector

UPS Uninterruptible Power Supply

WAP Wireless Access Point

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 Not Used

END OF SECTION

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
27 05 26

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the grounding and bonding for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 References

.1 Comply with the latest addition of the following applicable specifications and standards except as otherwise shown or specified.

.2 Underwriters Laboratories, Inc (UL).

.3 ANSI/TIA 607 requirements (current version including all addenda): Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.4 Quality Assurance

.1 All materials, equipment and parts comprising the unit’s specified within this document shall be new and unused and of a current manufacture.

.2 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.5 System Description

.1 The main entrance facility/equipment room shall be equipped with a TMGB. The TMGB shall be connected to the building electrical entrance grounding facility. In all other telecommunications / IT rooms there is to be a TGB; these are to be connected back to the TMGB through appropriately sized copper conductors that form the TBB.

.2 An electrical engineer is to provide the correct sizing of the ground wire for 1.5.1. Conductors shall be sized according to distance and must be stranded copper with green insulation.

.3 In each telecommunications room provide #6 AWG stranded copper with green insulation from the TGB to all metallic components (cable trays, racks and all other enclosures) regardless of whether equipment is

existing unless a grounding wire already is installed. No serial connections are acceptable.

.4 The TMGB must meet ANSI/TIA 607 requirements for network system grounding applications. Must be made of high conductivity copper and tin-plated to inhibit corrosion. Minimum bar size must be
4"W x ¼"H x 12"L with insulators and standoffs. Must be pre-drilled, complete with 12 x ¼" stud holes with ⅝" hole spacing and 6 x ⅜" stud holes with 1" hole spacing. 1.5.5 The TGB must meet ANSI/TIA
607 requirements for network system grounding applications. Must be made of high conductivity copper and tin-plated to inhibit corrosion. Minimum bar size must be 2"W x ¼"H x 12"L with insulators and standoffs. Must be pre-drilled, complete with 6 x ¼" stud holes with ⅝" hole spacing and 3 x ⅜" stud holes with 1" hole spacing.

.5 The contractor must visually inspect the Grounding and Bonding System for loose connections. A potential difference test must be made between the TMGB and electrical ground, and between the TMGB and each TGB. All test measurements must comply with the ANSI/TIA 607 requirements.

1.6 Submittals

.1 Shop drawing to reflect the type and size of the TMGB and the TGB for review.

.2 Provide a ground test report in compliance with the ANSI/TIA 607 requirements.

2 PRODUCTS

2.1 Acceptable Manufacturers

.1 Thomas and Betts, Chatsworth Products Inc., Burndy, Panduit or approved equal.

3 EXECUTION

3.1 Installation

.1 Bond all telecommunication cable trays, data cabinets, data racks and all other metallic communication infrastructure components to the nearest TMGB or TGB using a minimum of a #6
AWG stranded, green insulated conductor and appropriate 2-hole, long barrel, window lug.

.2 Contractor to ensure that the data rack and/or cabinet grounding does not block and/or interfere with any rack mount units in the racks and/or cabinets.

.3 Racks and/or cabinets are to be grounded at their top the TMGB or TGB.

.4 Bonding connectors shall be continuous and routed in the shortest straight path. Any bends placed in the connector shall be sweeping bends.

.5 A yellow ground tag to be supplied and installed by the contractor at the TMGB and TGB that states the following “IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CONTACT PHONE NUMBER ____”. Verify with the Owner the correct phone number.

.6 Provide a record of the ground resistance measurements from the ground bus to earth.

.7 Furnish all test results to be reviewed by an electrical engineer.

.8 All installations must be performed by licensed unionized (IBEW) electricians/telecommunication technicians. The tradesperson must follow the latest safety requirements from the Ministry of Labour.

.9 The contractor shall provide installers trained in the applicable codes, regulations and installation standards. Quality workmanship of the highest standard is expected to be delivered by the tradespersons. Acceptance of the work is subject to the approval of the university's designate and IT contact.

END OF SECTION

HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS
27 05 29

1 GENERAL

1.1 Work Included

.1 Comply with the general requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the hangers and supports for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 Hangers and supports are to be supplied and installed as per this document and drawings to support the various cabling from the workstation to the overhead cable tray or to the MTR and/or TR locations.

1.5 Submittals

.1 Shop drawings for each type of product indicated in the following document, including construction details, material descriptions, dimensions of individual components and profiles and finishes for the products listed. Include rated capacities, operating characteristics along with furnished specialties and accessories.

2 PRODUCTS

2.1 Adjustable Cable Supports (Cable Slings)

.1 Suitable for use in air handling spaces.

.2 Allow for attachment to ceilings, beams, walls, threaded rods and underfloor supports.

.3 Support a minimum cable capacity of 210 Cat6A or 325 Cat6 cables.

.4 Support a minimum static load of 46kg (100lbs).

3 EXECUTION

3.1 Installation

.1 The horizontal cabling pathway shall be a self-supporting system.

.2 Cable supports shall not be attached to ceiling grid support rods, conduits, water pipes HVAC ducts or lighting fixture wires.

.3 The cable supports shall be installed no more that 1.5 meters (48") apart.

.4 All cable supports shall be rated for a minimum of CAT6 for the structured cabling infrastructure.

.5 In a ceiling distribution design, the cable supports shall be installed at a minimum of 36" clearance between the ceiling tile and the structured cabling pathway.

.6 All hangers, rods and supports must be suspended from or attached to the structural steel, concrete slab and or walls with proper hardware designed to support their load bearing rating.

.7 Only touch-fasteners (a.k.a. velcro fasteners) shall be used where required. Under no circumstances plastic zip ties and similar products shall be utilized.

.8 Where support for horizontal cable is required, the contractor shall install appropriate sized cable supports to support the horizontal cabling listed in this document.

.9 J-hooks are not permitted.

.10 To minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when installing cable supports for the horizontal cabling pathway:

CLEARANCES TABLE

Item	Minimum Clearance
Motor	1.2 m (4'-0")
Transformers	1.2 m (4'-0")
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1'-0")
Conduit and cables used for electrical distribution greater than	1.0 m (3'-0")
Fluorescent Luminaires	12 cm (5")
Pipes (gas, oil, water, ETC.)	0.3 m (1'-0")
HVAC (equipment, ducts, etc.)	15 cm (6")

END OF SECTION

CONDUITS AND BACK BOXES FOR COMMUNICATION SYSTEMS
27 05 33

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the conduits and back boxes for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 The conduits and telecommunication boxes are to be supplied and installed as per this document and drawings to support the various cabling from the workstation to the overhead cable tray or to the MTR and/or TR locations.

1.5 Submittals

.1 Shop drawings for each type of product indicated in the following document, including construction details, material descriptions, dimensions of individual components and profiles and finishes for the products listed. Include rated capacities, operating characteristics along with furnished specialties and accessories.

2 PRODUCTS

2.1 Conduit

.1 All indoor conduits shall be thin wall EMT reamed and bushed at both ends.

.2 The external surface of all visible indoor conduits shall be painted as to match colours already existing on the surrounding structure so as not to create an unpleasant view.

.3 Conduits exposed to the weather, in wet locations, subject to mechanical injury, or in any hazardous locations or where required by code, shall be rigid threaded, galvanized steel conduit.

.4 Joints in conduits installed underground, in concrete slab on grade or in a concrete duct bank shall be made completely watertight.

2.2 In-Slab Floor Boxes

.1 All in slab floor boxes shall be constructed of galvanized steel and includes a lid assembly.

.2 Box equipped with conduit knockouts at each end and on each side for conduit feeds for data cabling and power.

.3 The lid to be available either recessed for carpet or tile or a flat flush lid.

.4 The lid shall have an open for the easy access for data patch cords and power cords.

.5 The floor box shall be a minimum of 12” x 12” x 5” deep.

.6 Joints in conduits installed underground, in concrete slab on grade or in a concrete duct bank shall be made completely watertight.

.7 Minimum concrete thickness over or around a conduit in a concrete slab shall be 75mm (3").

2.3 Metal Raceway

.1 The single raceway shall be steel.

.2 ScuffCoat scratch-resistant finish.

.3 Resists oxidation, corrosion and fading.

.4 Can be installed as recessed or surface.

.5 Various types of fittings for horizontal and vertical pathways.

.6 Use surface mount box for voice and data cabling.

3 EXECUTION

3.1 Installation

.1 The inside radius of a bend in a conduit shall be at least 10 times the internal diameter of the conduit.

.2 All zone conduits shall be identified and labelled at both ends. Tags shall identify the start and finish of conduit runs. Pull boxes shall be labelled on the exposed exterior.

.3 All conduits dedicated for the communication structured cabling system shall not be shared with other services.

.4 The telecommunication system shall be labelled green from end to end on conduits and at pull boxes.

.5 All conduits shall originate and be physically connected to the MTR, TR, backboards, cable tray and pull boxes.

.6 All fittings, connectors and couplings are to be steel.

.7 All conduits entering or exiting through the ceilings or walls of the MTR and or TR shall be installed to the basket cable tray in the room and stop 6" above the cable tray.

.8 All conduit runs shall follow the building grid lines and shall be concealed where possible.

.9 Unless otherwise specified, all conduit runs shall be a maximum of 30 meters (100 feet) in length with a maximum of two ninety-degree bends between pull boxes.

.10 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.

.11 In all instances pull boxes shall be placed in straight sections of a conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other.

.12 Conduit fittings or pull elbows fittings shall not be used in place of pull boxes or bends.

.13 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for the installation of cables is not prohibited.

.14 Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel.

.15 Provide and install 25mm (1") diameter green dot decals on the ceiling T-bar rail showing location of pull box.

.16 Pull boxes shall be constructed and sized in accordance with the Canadian Electrical Code and
ANSI/TIA standards of gauge steel and shall have a rust resistant finish.

.17 Place pull boxes in readily accessible locations only.

.18 Locations and sizes of all pull boxes shall be indicated on the design submission.

.19 Pull boxes shall be placed in straight sections of a conduit run and shall not be used in lieu of a bend.
Corresponding ends of the conduit arte to be aligned with each other. Conduit fittings or pull elbow fittings shall not be used in place of pull boxes or bends.

.20 All conduits shall be installed in accordance with the Canadian Electrical Code, Part 1 Section 12, applicable building codes and in accordance with TIA/EIA 569-B.

.21 The use of C, LB, LL, LR and T type fittings or elbows fittings is not permitted.

.22 Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100mm (4") and no more than 150mm (6") from the top of the cable tray. Conduit runs shall not be punched through the side of the cable tray.

.23 The minimum size (inside diameter) for EMT conduit running between the MTR and the telecommunications outlet location is twenty-five millimeters (25mm) (1").

.24 The formulas below should be used to calculate the maximum number of UTP cables per conduit size, at a maximum 40% fill ratio. The ensuing chart provides an example for Cat6E

(.288OD) cables in various conduit sizes.

Conduit outside diameter = C*od*
Conduit wall thickness = C*wt*
UTP cable outside diameter = U*od*

(a) $((Cod - Cwt*2)^2)*\Pi*0.1$

(b) $(\Pi*(Uod)^2)/4$

(c) TRUNC (a/b)

National Pipe Size (NPS)	Outside Diameter	Wall Thickness (Sch 40 / Std)	Maximum Number of UTP Cables
¾"	1.050	0.113	3
1"	1.315	0.133	5
1 ¼"	1.660	0.140	9
1 ½"	1.900	0.145	12
2"	2.375	0.154	20
2 ½"	2.875	0.203	29
3"	3.500	0.216	45
3 ½"	4.000	0.226	60
4	4.500	0.237	78

.25 Cable fill capacities of conduit, cable tray and raceways shall not be greater than 40%.

.26 A pull cord or fish tape shall be installed in all conduits.

.27 Conduit must enter the outlet boxes from the top or bottom.

.28 The contractor is responsible for cleaning all conduits prior to pulling any cable.

.29 The outlet boxes shall be installed in the locations identified on the drawing. The outlet box shall be installed at 300mm (12") AFF or at the same height and within 300mm (12") of the adjacent electrical duplex receptacles, unless otherwise noted on the drawings. Wherever possible, the face of the plastic ring should be installed flush with the finished wall.

.30 Back to back outlet boxes shall not be used.

.31 Outlet boxes must be equipped with a plaster ring to accommodate the installation of the multimedia faceplate.

.32 Plaster rings will be specified as a single or double gang to accommodate cabling

requirements.

.33 Plaster rings or raised adapter plates shall not reduce the size of the outlet such that two additional outlets could not be added in the future.

.34 In slab floor boxes are to be sized to reflect the total quantity of data cabling along with power requirements.

.35 If AV cabling is to be combined with data cabling the in-slab floor box needs to enlarged and reviewed by the IT department for approval.

.36 See conduit fill chart in item 3.1.24 related to the size of conduits that are required for the number of data drops for floor boxes.

.37 Quality and workmanship shall be at the highest of professional tradesman levels to be accepted for completion.

.38 To minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when installing the horizontal conduits for the horizontal cabling pathway:

CLEARANCE TABLE	
Item	Minimum Clearance
Motor	1.2m (4'-0")
Transformers	1.2m (4'-0")
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1'-0")
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3'-0")
Fluorescent Luminaires	12 cm (5")
Pipes (gas, oil, water, etc.)	0.3 m (1'-0")
HVAC (equipment, ducts, etc.)	15 cm (6")

.39 For concrete wall locations the single channel shall be used and properly secured to the block wall.

.40 If more than two data cables are to be installed at a single location the metal raceway is to be sized to accommodate the total number of data cables using the 40% fill ratio.

.41 At the faceplate location a surface wiremold box is to be connected using proper mounting hardware to install voice and data cabling in a communication faceplate

END OF SECTION

CABLE TRAYS FOR COMMUNICATION SYSTEMS
27 05 36

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the cable tray for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 Comply with EIA/TIA 569-B Commercial Building Standard for Telecommunication Pathways and Spaces.

.2 Only products and applications listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 Provide an appropriate cable tray solution within the ceiling space of an area as indicated on the drawings.

.2 Cable tray supports shall be installed at intervals of no more than 6 feet. At each interval, appropriate support (trapeze hangers, central hangers, cantilever arms) will be selected from the products listed in this document (Section 2) based on the following criteria:

.1 If the cable tray is to be installed on or against a wall, cantilevered arms shall be used to support the tray (see 2.3 of this document).

.2 If the ceiling area does not have enough clearance to accommodate two support rods per support point, a cable tray system based on the T-shape tray will be installed.

.3 In all other cases, a trapeze cable tray mounting method will be used. This is the least desirable solution and should be avoided.

.3 Coordinate layout and installation of cable trays and their suspension system with other construction that penetrates ceilings or is supported by them, including all light fixtures, HVAC equipment, fire suppression system and partitions.

.4 Cable tray systems should be designed and installed with adequate room around the cable tray to allow for the setup of cable pulling equipment. Also, space around the cable tray provides easy

access for installation of additional cables or the removal of surplus cables. See subsection 3.1.12 for details.

.5 Provide all fittings and miscellaneous hardware necessary to provide complete cable tray solution.

Miscellaneous hardware includes, but is not limited to: coupling nuts, hex nuts, clamps, washers, bolts, hinges, splices, expansion joints and couplers.

1.5 Submittals

.1 Shop drawing to reflect the type, size and material finish of the cable tray for review.

.2 Provide fabrication and installation details of the cable trays along with all components and attachments including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies, straight lengths and all fittings.

2 PRODUCTS

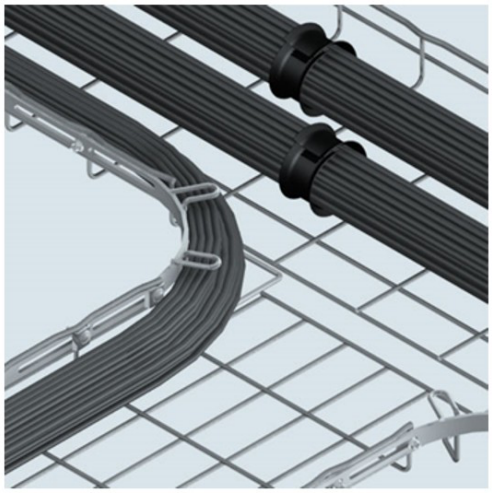
2.1 Cable Trays

.1 Cable tray material must be steel mesh or Aluminum Association Alloy 6063, similar to this picture:

Overhead Basket Cable Tray

.2 Straight sections shall be supplied in standard 10-foot (3.05m) lengths

.3 2.1.3 All bends in cable tray, including 90º, 45º bends, and tee intersections shall be “radius bends” with a minimum internal bend radius of 5”. See below picture as example:



.4 Minimum height of cable tray for horizontal cabling is 2 inches.

.5 Width of cable tray will be selected based on available clearance in selected cable tray pathway. Largest cable tray width available which still fits in selected pathway with appropriate clearance will be provided. For example, if the pathway is 25” wide, and minimum horizontal clearance is 10” on each side, then the maximum available width for cable tray is 5”. If cable tray is available in widths of
4”, 6”, and 8”, then 4” wide cable tray must be supplied and installed.

.6 Minimum width of cable tray is 4 inches. If available space in a given pathway does not allow for a cable tray width of at least 4 inches, contractor shall report to the UTM contact for further instructions.

.7 Must conform to NEMA VE1 standards for load capacity.

.8 Must be certified E-30 to E-90 for fire and heat resistance.

2.2 Drop Outs

.1 Must be used anywhere cabling enters or exits the cable tray at an angle greater than 30°.

.2 Must be compatible with existing or new cable tray (compatible fasteners & supports).

.3 Examples are provided on the pictures below:

DROP OUTS

DROP OUTS

2.3 Cable Tray Supports – Cantilever Arms

.1 Must be compatible with cable tray and allow for cable tray to be securely fastened to a wall.

.2 Must be able to support between 68kg and 136kg (150 ~ 300 lbs) loads per span, based on width of cable tray:

.1 For cable width of 4”, each support must support up to 68kg (150lbs).

.2 For cable width of 6”, each support must support up to 82kg (180lbs).

.3 For cable width of 8”, each support must support up to 104kg (230lbs).

.4 For cable width of 12”, each support must support up to 136kg (300lbs).

2.4 Cable Tray Supports – Cental Hangers

.1 Must be compatible with cable tray and allow for cable tray to be securely fastened to a wall.

.2 Must be able to mount on ⅜” threaded rod.

.3 Must include protective sleeve around threaded rod to protect cables from friction damage.

.4 Must be able to support between 68kg and 136kg (150 ~ 300 lbs) loads per span, based on width of cable tray:

.1 For cable width of 4”, each support must support up to 68kg (150lbs).

.2 For cable width of 6”, each support must support up to 82kg (180lbs).

.3 For cable width of 8”, each support must support up to 104kg (230lbs).

.4 For cable width of 12”, each support must support up to 136kg (300lbs).

2.5 Cable Tray Supports – Trapeze Supports

.1 Must be compatible with cable tray and allow for cable tray to be securely fastened to a wall

.2 Must be able to mount on ⅜" threaded rod.

.3 Must be able to support between 68kg and 136kg (150 ~ 300 lbs) loads per span, based on width of cable tray:

.1 For cable width of 4", each support must support up to 68kg (150lbs).

.2 For cable width of 6", each support must support up to 82kg (180lbs).

.3 For cable width of 8", each support must support up to 104kg (230lbs).

.4 For cable width of 12", each support must support up to 136kg (300lbs).

3 EXECUTION

3.1 Installation

.1 Contractor shall be responsible for the complete supply and installation of the overhead basket type cable tray along with the installation of all supports, dropouts (waterfalls) fittings, connectors threaded rods, bolts, brackets, clips, and miscellaneous hardware for a complete basket cable tray and support system.

.2 Install overhead basket type cable tray as shown on the drawings, sketches and be securely attached under the installation guidelines of the cable tray manufacturer.

.3 The basket cable tray supports can be installed on either side of the tray or supported in the centre of the cable tray.

.4 There shall be no sharp edges on any cable trays, exposed rods, bolts, nuts etc.

.5 Cut back all exposed hanging rods to a maximum of 2" to prevent accidental injury.

.6 Cable tray is to be properly supported at the end of the tray at the wall locations in the TR locations.

.7 Contractor to supply and install properly sized and the correct quantity of dropouts (waterfalls) at the cabinet and or data rack locations for the total number of data cables plus 50% growth.

.8 The basket tray is to be cut to accept the waterfalls within the cable tray. No cabling shall run over the side of or under the cable tray.

.9 Ground cable trays as per Section 27 05 26.

.10 Quality and workmanship shall be the highest of professional tradesman levels to be accepted for completion.

.11 The contractor shall provide installers trained in the installation of the cable tray, regulations and installation standards.

.12 Clearances:

.1 Minimum of 6" vertical clearance from the top of the cable trays installed in tiers except where cables of 2" in diameter or greater are installed, then the clearance shall be 12".

.2 Minimum of 12" vertical clearance from the top of the cable trays installed to all ceilings, heating ducts, heating equipment and 6" for short length obstructions.

.3 Minimum of 10” horizontal clearance from the side of the cable tray mounted adjacent to each other or to walls or obstructions.

.4 Clearances for cable trays shall be in accordance with the Canadian Electrical Code C22.1-09.

.5 To minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when installing basket tray:

CLEARANCE TABLE

Item	Minimum Clearance
Motor	1.2 m (4’-0”)
Transformers	1.2 m (4’-0”)
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1’-0”)
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3’-0”)
Fluorescent Luminaires	12 cm (5”)
Pipes (gas, oil, water, etc.)	0.3 m (1’-0”)
HVAC (equipment, ducts, etc.)	15 cm (6”)

END OF SECTION

IDENTIFICATION FOR COMMUNICATION SYSTEMS
27 05 53

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the identification for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 The contractor shall furnish all labour, materials, tools and other equipment necessary to provide a complete labelling system for the horizontal and backbone (copper and fibre) cabling system.

.2 The contractor shall be responsible for completion of all work included in the contract and shall employ certified, skilled technicians as necessary to satisfy all work and trades.

2 PRODUCTS

2.1 Labels

.1 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.

.2 Cable wrap labels shall be self-laminating vinyl construction with a white printing area and a clear tail that self-laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

.3 Use label sheets designed for laser/inkjet printers size 7.6mm x 15.5mm (0.3in x 0.61in). E.g. Panduit part number C061X030FJJ

.4 Labels must use font 'Liberation Sans Narrow'. This is a family of open source fonts, free for use, that can be downloaded at: https://pagure.io/liberation-fonts/

3 EXECUTION

3.1 Installation

.1 All labelling should be unique across the entire intra-building and/or inter-building wiring infrastructure.

.2 Labels are to be mechanically printed using a laser/inkjet printer.

Font size 8 is the preferred size. However, font sizes 7 or 6 should be used if the entire information cannot fit adequately on the first or second lines of the label, as detailed further in this section. The following is an example mock-up of a patch panel labelling

.3 Hand written labels are not permitted on any backbone, horizontal voice and data cabling, faceplates, patch panels, fibre patch panels and GigaBIX type labelling hardware.

.4 Labels obscured from view will not be acceptable and will be replaced by the contractor at no cost to the client.

.5 One label should be attached to the front of the workstation faceplate, one to the front of the patch panel, and one within 10cm (approximately 4 inches) of each end of the horizontal Cat6 UTP cable. The labelling scheme for the horizontal cabling is as follows:

All labelling and patching schedules to come from UTM. The IT contact will produce the schedules
(an example follows below) in a spreadsheet for the data communications cabling contractor to use to print complete labels.

Room	Cabling Number	Patch Panel	Patch Panel Port	Patch Panel Position	TR Room	Label	Chassis	Switch Number	Switch Port
1074c	001	4	7	151	1091	D-1091-151 / D-1074C-001	1	1	16

From the example above, "D-1091-151 / D-1074C-001" represents a TWO-LINE label. The / (slash) represents a new line. This label will be seen as such when on the rack itself: D-1091-151
D-1074C-001

These labels are to be A SINGLE PIECE affixed above the port they are labelling, and cannot be cut in half and affixed above and below the port. The following is the information breakdown:

D = Data

1091 = Data communication closet room number

151 = The physical position in the patch panel of the cable in question. This number ranges from 001-
048 on the first (TOP) patch panel, followed by 049-096 on the second patch panel (NEXT DOWN FROM THE TOP), followed by 097-144 on the third patch panel, and so on.

/ = New line

D = Data

1074C = The room where the other end of the cable terminates, typically an office or classroom.

001 = The cable number for this cable in the area where the far side terminates. These numbers
MUST be unique and can never be reused inside the same area

.6 If adding voice and/or data cabling to an existing telecommunication room, a hybrid labelling scheme between the existing format in the area and the format described in 3.1.6 must be used. Since UTM has a large number of legacy labelling formats across campus, contractors MUST seek clarification about the hybrid scheme with the appropriate IT contact, on a per case basis.

.7 Each fibre port on the fibre strip in all fibre patch panels shall be labelled.

.8 Example F-01, F-02, F-03 etc.

.9 Each fibre patch panel shall indicate the destination along with fibre count in large font for ease of reading.

.10 Example: 12-STRAND SM DV2045A to IB073.

.11 Cabling contractor to supply and leave in the TR room 25% spare labels (voice and data cable wraps, faceplate labels, patch panels label sheets and BIX type labels) for future use.

END OF SECTION

TESTING FOR COMMUNICATION SYSTEMS
27 05 55

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the testing for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 System Description

.1 The contractor shall furnish all labour, materials, tools and other equipment necessary to provide manufacturer-certified test results, and minimum 25-year warranty for the voice, data, and backbone (copper and fibre) cabling system.

.2 The contractor shall be responsible for the completion of all work included in the contract and shall employ certified, skilled and trained technicians as necessary to satisfy all work and trades.

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 Voice and Data Testing

.1 Cabling test results for every UTP cable, voice and data, must be provided at least 5 business days before commissioning of any data drop. Such results must be provided as both PDF and native tester files (e.g. FLW file).

.2 All tests will be full certification tests to current industry standards. All test results to be submitted to the manufacturer to produce a full certification report and warranty certificate covering the installed infrastructure for a minimum of 25 years.

.3 All terminated horizontal voice and data cable runs shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements found
in the TIA/EIA-568-C series of standards. All pairs in each installed cable shall be verified prior

to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed runs.

.4 Acceptable testers are as follows:

.1 Fluke DSX 5000 or equivalent.

.2 Fluke DSX 8000 or equivalent.

.5 The contractor shall test all four pairs of communications data UTP cabling runs to full compliance of EIA/TIA 568C performance parameters including, but not limited to, the following parameters: end to end attenuation, noise, resistance, PSNEXT, ELFEXT, PS ELFEXT, ACR, PS ACR, Delay Skew, Propagation Delay and Signal Loss measurements for Category 6 compliance in accordance to EIA/TIA 568C Category 6 standards. Full bandwidth, graphical results of all tests must be provided for all cables.

.6 Upon completion of the testing by the contractor, the contractor will submit the test results for the various work activities to the IT contact.

.7 Failure to provide UTP test results will require the contractor to retest all horizontal voice and data cabling related to the project with no cost to the client.

.8 All horizontal permanent link tests are to be performed using one of the approved testers equipped with the most recent version of its firmware and in accordance to ANSI/EIA/TIA-568-C series.

.9 Ensure all launch testing cables and connectors are within the parameters set by the manufacturer for the number of insertions for copper.

.10 Tester to be calibrated within one year of testing date.

.11 The technicians must be able to provide successful completion documents for one of the approved tester training courses upon request.

END OF SECTION

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK
27 11 23

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the communication cable management and ladder rack for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 Only new products listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 The cable management to be supplied and installed as per this document and drawings for proper routing of fibre and UTP patch cords from the network hardware associated with this project.

1.5 Submittals

.1 Shop drawings for each type of product indicated in the following document, including construction details, material descriptions, dimensions of individual components and profiles and finishes for the cable management. Include rated capacities, operating characteristics along with furnished specialties and accessories.

2 PRODUCTS

2.1 Vertical Wire Managers

.1 Frame shall be black with a smooth paint finish, single sided vertical manager with door and back- cover.

.2 Fabricated of 16 GA (0.060”) steel.

.3 Channel style supports heavy cable load, while maintaining clean concealed appearance.

.4 The vertical cable manager shall have a hinged door with a positive locking mechanism (non-magnetic).

.5 The vertical wire manager shall have stiffeners welded inside for additional strength.

.6 The openings for cable routing shall have finger type openings to ensure smooth transition of the patch cords without removing the patch cord from the patch panel or switch.

.7 The vertical wire managers shall have the ability to fasten cable ties externally to the rear of the cable manager.

.8 Each vertical wire manager shall have at least three (3) easily removable metal or plastic patch cord spools for ease of patch cord management.

.9 The horizontal patch cord spools are to be at least expandable to 10".

.10 The vertical wire managers shall be a minimum of 12" wide x 9" deep.

.11 The end vertical wire managers shall be a minimum of 6" wide x 9" deep.

2.2 Horizontal Wire Managers

.1 To be used only in existing TR locations.

.2 Fabricated of 16 GA (0.060") steel.

.3 All managers mount in 19" EIA standard mountings

.4 Designed to hide and organize cabling.

.5 Shall have a hinged door with a positive mechanism (non-magnetic).

.6 Shall have at least a 7" deep profile to maintain proper bend radius of the patch cables.

.7 Shall have openings for cable routing. Shall have finger type openings to ensure smooth transition of the patch cords without removing the patch cord from the patch panel or switch.

.8 Shall be a minimum of 3-1/2" high x 7" deep (2U).

3 EXECUTION

3.1 Installation

.1 Install vertical wire managers to the data racks in the MTR or TR location as identified within this document and associated drawings.

.2 Utilize proper and all fasteners for the vertical wire managers.

.3 The 2U horizontal wire manager shall be installed after every 48-port patch panel.

END OF SECTION

DATA COMMUNICATIONS HORIZONTAL CABLING
27 15 01 19

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the horizontal data cabling for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 All materials, equipment and parts comprising the unit's specified within this document shall be new and unused and of a current manufacture.

.2 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

.3 All horizontal data cabling must be certified to manufacturer's warranty of at least 25 years

1.4 System Description

.1 The horizontal data cabling and its connecting hardware provides the means of transporting signals between the telecommunication outlet/connector and the horizontal cross connect location in the MTR or TR locations. This cabling and its connecting hardware are called the "Permanent Link" a term that is used in testing protocols.

.2 The horizontal data cabling shall not contain any transition points or consolidation points between the horizontal cross-connect and the telecommunications outlet/connector. If a transition point or consolidation point is necessary for the functionality of the horizontal data cabling, a request shall be submitted to the IT contact for approval.

.3 Bridge taps and splices shall not be installed in the data horizontal cabling.

.4 The maximum distance for horizontal data cabling is 90m (295 feet).

1.5 Performance Requirements

.1 The complete end-to-end horizontal cabling system shall meet or exceed the requirements for Category 6 cabling as specified by the TIA/EIA-568-C.2 Telecommunication Cabling Standard.

.2 The complete end-to-end horizontal cabling system shall meet or exceed the requirements for Class E cabling as specified by the ISO/IEC 11801 International Standard.

1.6 Submittals

.1 Shop drawings shall be submitted for each type of product indicated or equivalent in the following document.

2 PRODUCTS

2.1 Balanced Twisted-Pair Cables

.1 The 4-pair balanced Cat6 UTP cables shall be in bonded-pair configurations.

.2 Data cabling shall be Cat6 for all cabling projects. Minimum cable rates are as follows: available bandwidth 300MHz, insertion loss 18.5dB @ 100MHz, return loss 16dB @ 100MHz.

.3 The Cat6 cables will be plenum rated (CMP or CMR). The minimum recommended installation temperature shall be 5°C (40°F). The temperature rating shall be 60°C (140°F).

.4 The horizontal Cat6 data cable jackets shall be blue in colour, and its hue shall be as close as possible to colour code #0000FF.

.5 The cables shall have randomization elements along their lengths and on their cross-sections to minimize alien near-end crosstalk (ANEXT) coupling.

.6 The cable conductors shall be 24 AWG solid copper.

.7 The outside diameter (OD) shall be no greater than 6.73mm (0.265").

.8 The minimum bend radius shall be no greater than four times the OD of the cable.

3 EXECUTION

3.1 Data Cable Installation

.1 The contractor shall clarify with the IT contact the ANSI/TIA termination standard that must be employed, prior to commencing the work

.2 No data cable shall exceed 90 meters. Any cables longer than 90 meters shall be reported immediately to the IT contact.

.3 Pair untwist at the termination point shall not exceed 13mm (0.5").

.4 Bend radius of the cable along its pathway and at the termination areas shall not be less than four times the OD of the cable.

.5 The pulling tension on any 4-pair balanced UTP cable shall not exceed 110N (25lbf).

.6 All cable ties shall be black, touch-fasteners (a.k.a. velcro fasteners) style.

.7 No plastic cable ties are allowed. If found on site during any phase of the project the plastic cable ties will be removed by the contractor at the contractor’s expense.

.8 All exposed cables in TRs are to be placed in a neat and professional manner and routed in accordance with the specifications and drawings provided.

.9 If installing horizontal data cabling outlets/connectors through floors/walls and into furniture access locations, all exposed cabling at the workstation between the wall/floor and the furniture access locations is to be wrapped with black split loom tubing, size and length as required to suit.

.10 Cable raceways shall not be filled greater than the TIA/EIA-569-B recommended maximum fill for the particular raceway type, or 40% whichever is less.

.11 Cable support systems shall be provided and installed by contractor everywhere along the cable pathway and shall adhere to the following:

.1 Existing cable tray and adjustable cable support as defined in sections 27 05 29 and 27 05 36 shall be used where available. Existing cable supports not specified in those documents (e.g. J- hooks) shall not be used for new cabling, new cable supports shall be installed adjacent to them

.2 All cable support systems shall be self-supporting.

.3 At no point shall cable(s) rest on acoustic ceiling grids, water pipes, metal conduits, ceiling panels or any other structure not defined as a cable support.

.4 Horizontal data cabling shall be supported by use of cable trays where clearances allow for the installation of cable trays. See section 27 05 36 for details on cable tray systems and minimum required clearances.

.5 Where clearances do not allow for the installation of cable trays, contractor shall submit a request to the IT contact for additional instructions. UTM I&ITS may, at its own discretion, lower the minimum required clearances to allow for the installation of cable tray, or instruct contractor to use alternate cable supports as defined in sections 27 05 29 and 27 05 33.

.12 Horizontal data cables shall be bundled in groups of no more than 16 cables. Cable bundle quantities in excess of 16 cables may cause deformation of the bottom cables within the bundle, which will degrade the performance of those cables.

.13 The horizontal data cable shall be installed above fire-sprinkler systems and shall not be attached to such systems or any associated ancillary equipment or hardware. The cabling system and its associated pathways shall be installed so that they do not obscure any valves, fire alarm conduit(s), boxes, or other control devices.

.14 Any data cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the owner of the cabling system.

.15 All data cables shall be identified by a self-adhesive label in accordance with the Identification for Comm. System section of this specification, Section 27 05 53.

.16 Any data cable located on a penthouse level for other services (BAS, elevator room, mechanical room, electrical room) shall be installed to the closet TR location via conduit.

.17 All data cables must be terminated on the same floor as the workstation location. The exception to this rule is item 3.1.16.

.18 Coloured jacks will be used to differentiate cable types. The colour scheme for 8P8C modular connector jacks (a.k.a. RJ45) is the following:

Description	Cable Type
MDVO Style T568A/B, Blue	Workstation Data Cabling
MDVO Style T568A/B, White	Voice Cabling
MDVO Style T568A/B, Yellow	Security Cabling
MDVO Style T568A/B, Orange	Wireless Access Point Data Cabling
MDVO Style T568A/B, Red	Building Automation Data Cabling

.19 minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when routing cables:

CLEARANCE TABLE	
Item	Minimum Clearance
Motor	1.2 m (4’-0”)
Transformers	1.2 m (4’-0”)
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1’-0”)
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3’-0”)
Fluorescent Luminaires	12 cm (5”)
Pipes (gas, oil, water, etc.)	0.3 m (1’-0”)
HVAC (equipment, ducts, etc.)	15 cm (6”)

END OF SECTION

COMMUNICATION FACEPLATES AND CONNECTORS
27 15 43

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the faceplates and connectors for the communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 All materials, equipment and parts comprising the unit's specified within this document shall be new and unused and of a current manufacture.

.2 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 The horizontal voice and data connectors provide the means of transporting signals between the telecommunication outlet/connector and the horizontal cross connect location in the MTR or TR locations.

1.5 Performance Requirements

.1 The voice and data connecting hardware shall match the horizontal voice and data cabling specifications for performance

1.6 Submittals

.1 Shop drawings shall be submitted for each type of product indicated or equivalent in the following document

2 PRODUCTS

2.1 UTP Connectors

.1 Minimum rates for the 8P8C modular connector jacks (a.k.a. RJ45) are as follows: insertion loss 0.10dB @ 100MHz, return loss 27dB @ 100MHz.

.2 The PSANEXT isolation between modules must be greater than 70dB @ 100 MHz when connectors are mounted side by side, top to bottom in a 48 ports 1U configuration.

.3 The connectors shall be modular in form, with available mounting options for TOs and flat type patch panels. The dimensions of the connectors shall be as follows:

- (0.78 in) in height
- (0.64 in) in width
- (1.14 in) in depth

.4 When mated to cordage, the transmission characteristics of the connectors will be guaranteed to be 300MHz.

.5 White 8P8C modular connector jacks are required for the voice telecommunication workstation outlet.

.6 Blue 8P8C modular connector jacks are required for the data telecommunication workstation outlet.

.7 Additional colour details for 8P8C modular connector jacks are found in section 27 15 01 19 – 3.1.18.

2.2 Faceplates

.1 Available in 2, 4 and 6 port configurations for greater workstation outer density.

.2 Faceplates shall be available in multiple colours to match any suit décor.

.3 Faceplates are compatible for Cat6 8P8C modular connector (MDVO).

.4 Space to facilitate outlet labelling identification and ease of network management.

.5 Blanks supplied to fill all unused ports.

.6 Faceplates to fit over standard NEMA type outlet boxes or wall mounting bracket for flush mounting installations

.7 Faceplates shall be able to fit over an interface adaptor boxes for surface mount installations.

3 EXECUTION

3.1 Voice Connector Termination

.1 At the workstation faceplate terminate each voice cable on a white 8P8C modular connector jack wired TIA/EIA-568A ISDN standard.

.2 For all voice locations there shall be one Cat6 voice cable terminated at each end as per this document.

.3 The voice 8P8C modular connector jack will be white in colour and shall occupy the far-right position of the 4-port white faceplate (top to bottom).

.4 Use blanks for all unused ports. Blanks to match faceplate colour.

.5 Where communications are ganged with electrical décora type, inserts are to be used and the colour is to match electrical.

.6 Where the voice cabling is terminated at a furniture workstation the 4-port white faceplate shall be installed in a white interface surface adaptor box and secured to the furniture base using short self- tapping screws. (Do not install the self-adhesive product that is with the interface surface adapter box)

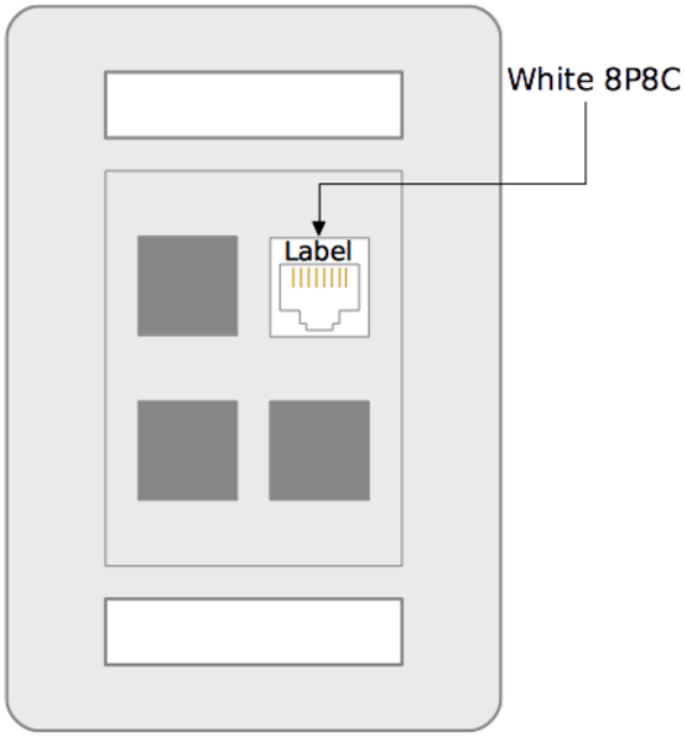
.7 Include all necessary furniture adaptors/spacers/surface boxes/MDVO type jacks and any other hardware required to ensure the faceplate can be properly installed/secured to the furniture while maintaining a proper bend radius.

.8 Include all necessary adaptors/spacers/surface boxes/ MDVO type jacks and any other hardware required to ensure the faceplate can be properly installed in the floor box while maintaining a proper bend radius.

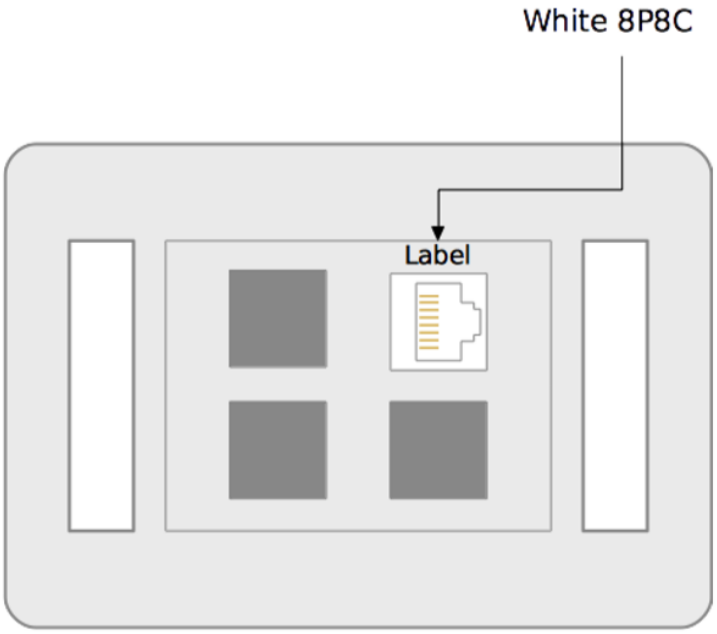
.9 Any voice cable damaged or exceeding recommended installation parameters during termination shall be replaced by the contractor prior to final acceptance at no cost to the owner of the cabling system.

.10 All voice cables shall be identified by a self-adhesive label in accordance with the Identification for Comm System section of this specification, 27 05 53.

.11 Each voice cable shall be clearly labeled on the cable jacket within 4 inches of the termination behind the connector at the faceplate and BIX or GigaBIX type connectors. Labels obscured from view will not be accepted and will be replaced by the contractor at no cost to the client



Wall Faceplate



Horizontal Faceplate

3.2 Data Connector Termination

.1 At the workstation faceplate terminate each data cable on a blue 8P8C modular connector MDVO
jack wired TIA/EIA-568A ISDN standard.

.2 The data 8P8C modular connector jack will be blue in colour and shall occupy the top left position of the 4-port white faceplate (top to bottom).

.3 Use blanks for all unused ports. Blanks to match faceplate colour.

.4 Where communications is ganged with electrical décora type inserts are to be used and the colour is to match electrical.

.5 Where the data cabling is terminated at a furniture workstation the 4-port white faceplate shall be installed in a white interface surface adaptor box and secured to the furniture base using short self- tapping screws. (Do not install the self-adhesive product that is with the interface surface adapter box).

.6 Include all necessary furniture adaptors/spacers/surface boxes/MDVO type jacks and any other hardware required to ensure the faceplate can be properly installed/secured to the furniture while maintaining a proper bend radius.

.7 Include all necessary adaptors/spacers/surface boxes/MDVO type jacks and any other hardware required to ensure the faceplate can be properly installed in the floor box while maintaining a proper bend radius.

.8 Any data cable damaged or exceeding recommended installation parameters during termination shall be replaces by the contractor prior to final acceptance at no cost to the owner of the cabling system.

.9 All data cables shall be identified by a self-adhesive label in accordance with the Identification for Comm. System section of this specification, 27 05 53.

.10 Each data cable shall be clearly labeled on the cable jacket within 4 inches of the termination behind the connector at the faceplate and BIX or GigaBIX type connectors. Labels are to be a self-laminating wrap around style. Labels obscured from view will not be accepted and will be replaced by the contractor at no cost to the client.

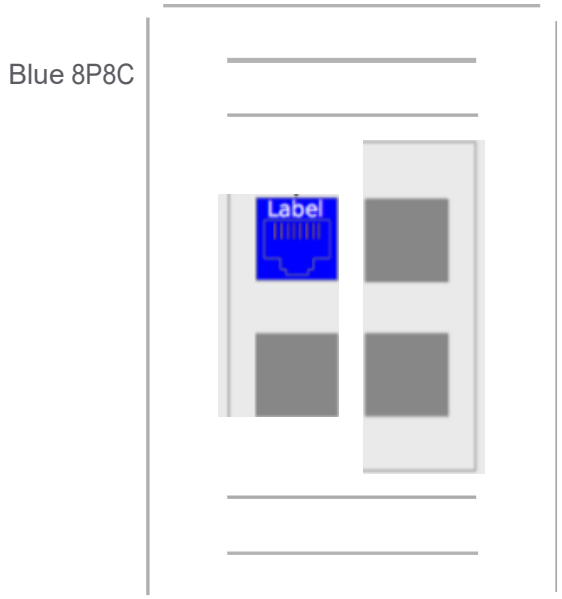
.11 The data cabling will be terminated on either existing patch panels or on new 48-port patch panels. I&ITS designate to confirm per project.

.12 If existing patch panels are full, the contractor is to install new, black 48-port patch panels (match existing) that is to be properly secured to the existing 19" data rack.

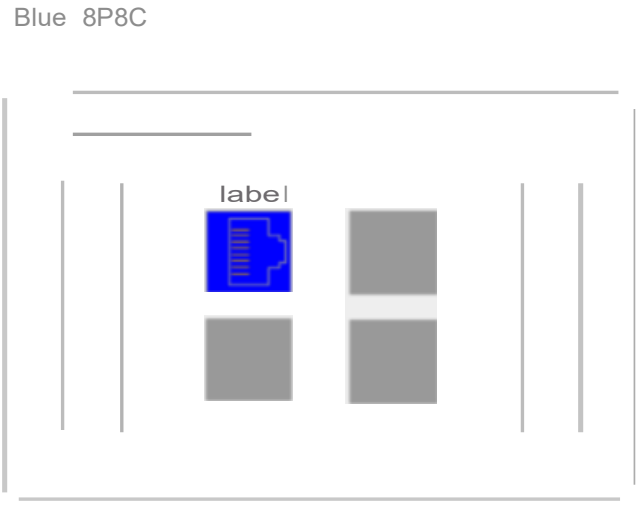
.13 If a new patch panel is installed below an existing full panel, a 2RU horizontal cable manager will be installed above the new panel to preserve the interlacing of patch panels and horizontal cable manger as per section 27 11 23.

.14 Pair untwist at the termination point shall not exceed 13mm (0.5in).

.15 All cable ties shall be black, touch-fasteners (a.k.a. velcro fasteners) style



Wall Faceplate



Horizontal Faceplate

END OF SECTION

COMMUNICATIONS PATCH CORDS, STATION CORDS AND CROSS CONNECT WIRE 27 16 19

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the patch cords, station cords and cross-connect wire for communications systems work specified within.

.3 To be read in conjunction with associated electrical and communication specification sections.

.4 The contractor should seek clarification from the UTM IT contact on site conditions and on any technical, work and/or premises-related questions without delay.

1.2 Related Documents

.1 Drawings and general provisions of the contract, including general and supplementary conditions apply to this section. Refer to the following for additional information.

.2 27 05 13 Communication Services

1.3 Quality Assurance

.1 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.4 System Description

.1 The data UTP and fibre patch cords provide the means of transporting signals between the telecommunication outlet/connector and the horizontal cross-connect location in the MTR or TR locations.

1.5 Performance Requirements

.1 The horizontal data patch cords are a minimum of 300MHz.

.2 The cross-connect wire shall be 4 pairs and match 300MHz.

1.6 Submittals

.1 Shop drawings shall be submitted for each type of product indicated or equivalent in the following document to be approved prior to installation.

2 PRODUCTS

2.1 UTP Patch Cords

.1 All data patch cords shall conform to the requirements of the ANSI/TIA 568-D series or the latest edition of the Commercial Building Telecommunication Cabling Standard for horizontal cabling section.

.2 The cordage shall use 24 AWG solid copper conductors in a bonded pair configuration for reliable long-term channel performance to 300MHz.

.3 The nominal cable diameter of the cordage shall be no greater than 6.62 mm (0.266 in). The minimum bend radius shall be no greater than four times the nominal cable diameter of the cordage.

.4 Patch cords are to be available in the following colours and lengths.

LENGTH	COLOUR
1.2m	Blue (colour code #0000ff)
2.1m	Blue (colour code #0000ff)
3.0m	Blue (colour code #0000ff)

3 EXECUTION

3.1 Installation

.1 Install the Cat6 UTP patch cords from the network switches to the data patch panel using the horizontal and vertical wire managers as per the supplied patching and labelling schedule received from the IT contact.

.2 Supply a Cat6 UTP patch cord for the workstation, and connect it to the data jack on the faceplate.
One per data drop installed.

END OF SECTION

AUDIO-VIDEO COMMUNICATIONS
27 40 00

1 GENERAL

1.1 Scope of Work

.1 Provide audio visual systems design, engineering, and installation within all spaces of the project, as defined by the related documents. Systems shall include all devices, equipment, installation, programming and commissioning in accordance with requirements of the contract documents and drawings. The installer must be Crestron-certified.

.1 The work detailed within the contract documents has been specified to meet certain requirements for performance, appearance, and costs. It shall be the responsibility of the Contractor to implement the guidelines and requirements contained in the contract documents and translate them into a complete design package containing all elements necessary for a complete, operational, and functionally integrated audiovisual system(s).

.2 Provide all work as detailed in the contract documents as a turnkey installation including all material, labor, warranties, taxes, freight, and permits. Only items and requirements specifically stated to be provided by others shall not be a requirement for this section of the work.

1.2 System Summary

.1 The audiovisual systems included are intended to provide audiovisual capabilities required for effective communication and presentation of information. The systems include the following:

.1 Display systems

.2 Video presentation systems

.3 Program audio/speech reinforcement systems

.4 Control systems

1.3 Submittals

.1 Provide product data for the following:

.1 Display equipment and systems

.2 Projection systems

.3 Safety certifications (UL, TUV, CE, etc.)

.2 Provide comprehensive flow diagram for all components, indicating part numbers and cable types, as well as recommended conduit sizes where applicable. Flow diagram should include the following at a minimum:

.1 Video equipment and systems

(a) Signal switching and processing equipment.
(b) All source equipment.
(c) Signal transmission.
(d) All cable types required for video and/or audiovisual signal transmission.
(e) Safety certifications (UL, TUV, CE, etc.)

.2 Program audio/speech reinforcement equipment and systems

(a) Signal switching and processing equipment.
(b) All source equipment.
(c) Signal transmission.
(d) Loudspeakers.
(e) Microphones.
(f) All cable types required for audio signal transmission.
(g) Safety certifications (UL, TUV, CE, etc.)

.3 Control system equipment and systems
(a) IP control system processors.
(b) Control system interfaces.
(c) All cable types required for control signal transmission.
(d) Safety certifications (UL, TUV, CE, etc.)

.4 Miscellaneous equipment and systems

(a) Audiovisual racks and rack accessories.
(b) Wall plates, table plates and floor box plates and inserts
(c) Materials
(d) Finishes
(e) Dimensions
(f) Safety certifications (UL, TUV, CE, etc.)

.5 Projection systems

(a) Projection equipment and accessories
(b) Mounting components
(c) Dimensions
(d) Safety certifications (UL, TUV, CE, etc.)

2 PRODUCTS

2.1 Wire and Cable

.1 All materials and components shall be new and of manufacturer's finest quality as appropriate to the application. Uniform materials and components shall be used throughout, and wherever possible, shall be field replaceable and commonly available.

.1 Products shall conform to applicable UL standards and to General Electrical Requirements.

.2 Some specific equipment and systems may require dedicated proprietary cabling produced by the equipment manufacturer. If these systems are specified, no substitutions are permitted.

.3 Note that these cable types are cited to illustrate the type and quality of cable required. Unless otherwise noted, cables from other manufacturers, i.e. West Penn, Comm-Scope, Liberty Cable, etc. will be considered acceptable if data sheets are submitted prior to installation.

.4 The Contractor shall only use plugs and jacks specifically manufactured and designed for the cable used. Unless otherwise noted, third-party connectors from other manufacturers, i.e. kings, switchcraft, amp, amphenol, lemo, etc. Will be considered acceptable if data sheets are submitted prior to installation.

2.2 Audio Applications

.1 Microphone/line level; fixed installation

.1 Miniature PVC insulated, #22 AWG stranded copper wire twisted pair with 100% foil shield and drain wire, in PVC jacket, 3.51 mm nominal overall diameter.

.2 Belden 8451, or approved equal

.3 Plenum equivalent - Belden 88761, or approved equal

2.3 Speaker Level; Fixed Installation; 18 gauge (70 volt distribution only)

.1 PVC insulated #18 AWG high strand count copper twisted pair, individually PVC insulated with black and white jackets, in an overall PVC insulated jacket, 4.67 mm nominal overall diameter.

.2 Belden 5300up, or approved equal

.3 Plenum equivalent - Belden 82740, or approved equal

2.4 Speaker Level; Fixed Installation; 16 gauge

.1 PVC insulated #16 AWG high strand count copper twisted pair, individually PVC insulated with black and white jackets, in an overall PVC insulated jacket, 5.28 mm nominal overall diameter.

.2 Belden 5200up, or approved equal

.3 Plenum equivalent - Belden 6200ue, or approved equal

2.5 Speaker Level; Fixed Installation; 14 gauge

.1 PVC insulated #14 AWG high strand count copper twisted pair, individually PVC insulated with black and white jackets, in an overall PVC insulated jacket, 6.6 mm nominal overall diameter.

.2 Belden 5100up, or approved equal

.3 Plenum equivalent - Belden 6100ue, or approved equal

2.6 Speaker Level; Fixed Installation; 12 gauge

.1 PVC insulated #12 AWG high strand count copper twisted pair, individually PVC insulated with black and white jackets, in an overall PVC insulated jacket, 7.67 mm nominal overall diameter.

.2 Belden 5000up, or approved equal

.3 Plenum equivalent - Belden 6000ue, or approved equal

2.7 Speaker Level; Fixed Installation; 10 gauge

.1 PVC insulated #10 AWG high strand count copper twisted pair, individually PVC insulated with black and white jackets, in an overall PVC insulated jacket, 9.04 mm nominal overall diameter.

.2 Belden 5t00up, or approved equal

.3 Plenum equivalent - Belden 6t100up, or approved equal

2.8 Antenna Cable – Wireless Microphone/Assistive Listening Emitter

.1 Coaxial cable, RG-8U, 50 Ohm, maximum VSWR 1.43:1 from 5 MHz to 2,250 Mhz.; equal to or better in high frequency attenuation performance at 2,250 MHz (-8.0 dB, 100') as specified, with braided shield for minimum 95% coverage and foil shielding for minimum 100% coverage, in an overall PVC insulated jacket, 11 mm nominal overall diameter.

.2 Belden 9913F7, or approved equal

.3 Plenum equivalent - Belden 88913, or approved equal

2.9 Device Interconnection; Relay Systems

.1 Two twisted pair stranded #22 AWG copper wire, individually jacketed, in an overall PVC jacket, 6.20 mm nominal overall diameter.

.2 Belden 9744, or approved equal

.3 Plenum equivalent - Belden 88741, or approved equal

2.10 Device Interconnection; RS-232/RS-422/RS-485

.1 Two twisted pair stranded #22 AWG copper wire, individually jacketed with individual shielding of pairs, in an overall PVC jacket, 4.39 mm nominal overall diameter.

.2 Belden 8723, or approved equal

.3 Plenum equivalent - Belden 88723, or approved equal

2.11 Device Interconnection; With Power

.1 One twisted pair stranded #22 AWG copper wire with shield; one #18 AWG TC unshielded power pair in an overall PVC jacket, 6.35 mm nominal overall diameter.

.2 Belden 1502r, or approved equal

.3 Plenum equivalent: Belden 1502p, or approved equal

2.12 Device interconnection; display systems

.1 One #24 AWG high-speed HDMI 2.1 cable.

.2 Plenum-rated

3 EXECUTION

3.1 General

.1 Check all control functions, from all controlling devices to all controlled devices, for proper operations.

.2 Adjust, balance, and align all equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for all level controls, and record these settings in the "system operation and maintenance manual".

.3 Check all optical projection images for average light level, light fall-off, and image alignment and size to comply with the performance standards and specifications drawings. Check to determine that all projectors, projector bases, carts, tables, and mirrors are rigid and vibration-less in operation.

.4 Maintain documentation of all performance tests for reference by the design team during the system acceptance tests

3.2 Programming and Control

.1 The control system will provide both user and advanced operator control. The control system will include network ports to allow both remote monitoring and control, as well as a local AV subnet for communication and control of in-room av devices.

.2 The user interface and system programming will be provided by the integrator in conjunction with a Crestron customer service professional (CSP) who will work directly with the integrator. The contractor will coordinate engineering and scheduling requirements directly with the CSP.

.3 Users will have the ability to start presentations, dial and accept audio and video conferencing calls, mute the microphones, and control volume. While in an active conference and displaying presentations, advanced volume control will allow individual muting and level control of the active presentation source and active conferences.

3.3 Training

.1 Contractor to provide training of fully installed system to owner designated personnel (2) weeks prior to turnover of system.

3.4 System Tests

.1 Before acceptance tests are scheduled, the contractor shall perform his own system tests. He shall furnish all required test equipment and shall perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. This work shall include the following:

.1 Provide documentation that all matrix switching cross-points have been tested and verified.

.2 Test all audio and video systems for compliance with the performance standards.

3.5 Video Systems

.1 Video test equipment:

.1 Multi-format video signal generator, Quantum Data 802 series, with HDMI and DVI support.

.2 Calibrated content for all media players that are part of the system.

.3 Blank media for all media recorders that are part of the system.

.4 All miscellaneous equipment, cables and terminations necessary for testing.

.2 Signal paths; video

.1 Connect the output of the video signal generator to each source input point (poke thru/table/rack panel, etc.) And select the "full field color bar" signal.

.2 Ensure that the test signal is routed to the selected output.

.3 Check that the image is filling the screen and is properly centered at all resolutions and timings that are industry standard and in use by the owner.

.4 Change test pattern to pluge pattern and ensure that there is no ringing in the image.

.5 Change test pattern to a full-field cross-hatch pattern and ensure consistent focus throughout the image.

3.6 Audio Systems

.1 Audio test equipment:

.1 Signal generator, leader lag-120b

.2 Time-based acoustic analyzer, Goldline TEF, SIA SMAART, Meyer SIM System II or approved equivalent, with all required accessories.

.3 Ac millivoltmeter, leader LMZ-181A.

.4 Audio test set, audio precision P1Plus.

.5 Pink noise generator IVIE IE-20B.

.6 Spectrum analyzer IVIE-IE30A.

.7 Harmonic and intermodulation distortion analyzer leader LDM-171.

.8 Loudspeaker and microphone polarity checker,

.9 Calibrated content for all media players that are part of the system.

.10 Blank media for all media recorders that are part of the system.

.11 All miscellaneous equipment, microphones, cables and terminations necessary for testing.

.2 Gain setting

.1 Adjust all components (starting at source equipment and ending at the power amplifiers or active loudspeaker inputs), for maximum signal-to-noise ratio per conventions outlined in sound system engineering, second edition (Don and Carolyn Davis, Howard W. Sams & Co. 1987).

.2 Provide a gain structure chart showing measured levels at each and every gain point through the system. This will be submitted as the reference setup for the system

.3 At the conclusion of audio system gain structure setting no hiss or noise should be audible through any loudspeaker, and ample electronic headroom should be available throughout the signal chain.

.4 At the conclusion of the tests, return all equipment settings to previously calibrated positions. All component settings are to be labeled, identified and documented.

.5 Provide written records of all test results in spreadsheet form.

.3 Signal paths; audio

.1 Measure and record the impedance of each active device operating as a source to any passive device or series of passive devices. Record the dc resistance of any build-out resistors used.

.2 Measure and record the input impedance of any active device used to terminate passive devices, and record the total impedance of all such devices. Record the dc resistance of any terminating resistor used.

.3 Measure the absolute polarity of all devices, including all loudspeakers in the signal path, correct and record any reversals.

.4 Adjust the gain of all devices in the signal path for optimum signal-to-noise ratio and maximum crest factor.

.5 Without changing gain, terminate microphone and line-level inputs, with shielded resistors of 150 and 600 Ohms respectively.

.6 Measure and record the overall hum and noise level at each power amplifier. Level shall be at least 75 dB below rated power output of amplifier over a bandwidth of 40-16,000 Hz.

.7 Measure and record the impedance of each loudspeaker line at 250, 1000, and 4000 Hz before connecting it to the output of its respective amplifier.

.8 Load power amplifiers with resistors matching nominal impedance of output terminals used in system in place of actual loudspeaker loads.

.9 Adjust gain of system as for hum and noise level tests above.

.10 Apply a 1,000 Hz. Sine-wave signal to each microphone and line-level input at level required to produce measured full amplifier output.

.11 THD shall measure less than 1.0%.

.12 Set up system for each specified mode of operation.

.13 Use wide-bandwidth oscilloscope and loudspeaker monitoring.

.14 Check to ensure that system is free of spurious oscillation and rf pickup in the absence of any input signal and also with the system momentarily driven to full output at 400 Hz.

.15 Feed full/wide-dynamic range music to the system. Adjust the system for frequent peaks at its specified maximum sound pressure level.

.16 Listen carefully for noise, rattle, or other extraneous sounds, and objectionable distortion.

.17 Correct all causes of such defects. If cause is outside system, promptly notify the construction manager and the consultant, indicating cause and suggested corrective procedures.

.18 Measure and record the acoustic distribution of the loudspeakers of this system at locations as designated by the consultant, one (1) in every zone. Record the location of all position where any
1/3 octave band, deviates more than +/-3 dB from 500 Hz to 4 kHz, weighted by –5 at 8,00 Hz re:
2500 Hz.

.4 Loudspeaker assemblies and associated systems

.1 Provide loudspeaker assemblies as shown on the drawings. Unless otherwise noted, the speaker types and quantities are as shown on the equipment schedule.

.2 Unless otherwise noted, the contractor shall provide complete assemblies, including back boxes
(enclosures) where applicable, grilles, mounting hardware, etc.

.3 Unless otherwise noted, the speakers shall be finished as directed by the architect.

.4 Should the design of the speakers make repainting the speaker, or otherwise refinishing the speaker impractical, the contractor shall provide the design team with the factory-available finishes for selection.

.5 All speakers shall be tested at the contractor's facility prior to delivery to the job site for installation.

.6 Testing of speakers shall be in the installed condition; speakers that will be installed in a back box shall be tested installed in the back box.

.7 All tests shall be performed with a dedicated loudspeaker measurement system, equivalent to the Linearx LMS system.

.8 Frequency sweeps shall be at the usable frequency response of the speaker. Testing shall include: SPL response (SPL versus frequency), impedance response (impedance versus frequency), time domain response (voltage versus time), mechanical testing (voltage versus frequency).

.9 All testing shall be documented and stored on media.

.10 Testing shall be performed on all speakers, including spares.

END OF SECTION

PUBLIC INFORMATION SYSTEM
(DIGITAL SIGNAGE)
27 42 13

1 GENERAL

1.1 System Description

.1 Public information system (Digital Signage System) that will be used to provide events information, announcements, campus and community updates, emergency broadcasts & university news and brand contents.

.2 In new construction and major renovations, digital signage systems and locations shall be integrated in the design process of the project so that appearance, circulation, traffic, accessibility and mounting systems are in line with the design approach.

.3 In existing buildings, appearance, circulation, traffic, accessibility and mounting system consideration should be taken in accordance with the SPMC application and FM&P procedures.

1.2 Related Works

.1 Work 1.2.1. UTM Communication Cabling Standard

.2 UTM Electrical Standards

.3 UTM IoT Design Criteria

1.3 Definitions

.1 DSS: Digital Signage System

.2 FM&P: UTM Facilities Management & Planning department

.3 SPMC: Space Planning & Management Committee

1.4 Quality Assurance

.1 The DSS contractor shall be responsible for providing, installing, configuring and testing of the public information system as per project requirements & drawings.

.2 The DSS contractor shall be responsible of providing all required certifications.

.3 The DSS contractor shall be responsible for the quality of all materials and workmanship of any firms or individuals who act as his subcontractors.

1.5 Submittals

.1 The DSS contractor shall provide full specification, shop drawings and documentation regarding all the installation, set-up, configuration and operation for both of the hardware & software of the DSS.

.2 The DSS contractor shall provide all cut sheets, manuals and required certificates and warranties for all products/materials used and shall get the UTM approval on all products prior installation.

1.6 Delivery, Storage, and Handling

.1 As per contract.

1.7 Environmental Requirements

.1 N/A.

1.8 Warranty

.1 Services support:

.1 The DSS contractor shall provide free unlimited support throughout the warranty period for the following:

1. Help desk via phone, email, and remote assistance within the work hours (9:00am-4:00pm), Monday through Friday.

2. Regular in person and/or web based training as per contract.

3. Premium content and templates as per contract.

.2 Hardware:

.1 The DSS contractor shall provide a minimum of three year warranty on all hardware products provided by him/her. The warrant commences from the date of project delivery and warrants that the product will be free from defects in materials and workmanship.

.2 No extra fare for shipping, handling and /or onsite visits incurred as a result of returning/repairing any of the products or parts with the warranty period.

Note: All labour & installation charges to be as per contract.

.3 Calibration:

.1 The contractor shall provide full calibration/alignment & testing for all provided products at the time of installation, as applicable.

.2 No Subsequent calibration shall be as per contract.

2 PRODUCTS

2.1 General

.1 DSS shall be placed in strategic and very visible locations with high traffic to better serve its purpose and communicate its message & information and also to deter thefts.

2.2 Materials and Equipment

.1 Mounting Systems:

.1 One or more of the following mounting systems shall be provided (as per contract):

.1 Typical wall mounting system: (For more details, please refer to layout no. 27 42 13 - 1)

a. Shall be of slim profile mount made out of steel with black color or to match wall/screen color.

b. Shall be designed to handle flat panel screens of minimum 55” size and loads up to 150lbs.
c. Shall be secure and a tamper- proof (such as providing a hex key).
d. Integrated locking and alarm features such as padlock, combination lock and Sonic Shock alarm or similar are recommended for further security.
e. Total protrusion from wall including screen shall not exceed 4” for accessibility requirements.

.2 Elevated wall mount system: (For more details, please refer to layout no. 27 42 13 - 2)

a. Shall be made out steel with black color or to match wall/screen color.
b. Shall be designed to handle flat panel screens of minimum 55” size, loads up to 150lbs and a tilt angle up to 15°.
c. Shall be secure and a tamper- proof (such as providing a hex key).
d. Integrated locking and alarm features such as padlock, combination lock and Sonic Shock alarm or similar are recommended for further security.

.3 Elevated ceiling mount system: (For more details, please refer to layout no. 27 42 13 - 2)

a. Shall be made out steel with black color or to match wall/screen color.
b. Shall be designed to handle flat panel screens of minimum 55” size, loads up to 150lbs and a tilt angle up to 15° and a swivel angle up to 360°.
c. Shall be secure and a tamper-proof hex key shall be provided.
d. Integrated locking and alarm features such as padlock, combination lock and Sonic Shock alarm or similar are recommended for further security.

.4 Floor mount system: (For more details, please refer to layout no. 27 42 13 - 1)

a. Shall be heavy duty concealed floor mount hook-up if applicable.

.2 Commercial grade digital signage flat panel screens:

.1 Minimum resolution of standard 1080p (1920x1080) native video resolution compatibility to ensure consistency of messaging across campus.

.2 Minimum 55” industry standard 16:9 wide screen commercial displays with shall be provided

.3 Display panel shall be of premium grade and shall be guaranteed for 24/7 operation with minimal controls accessible by the end user.

.4 Onboard/integrated computer option shall be provided for all new digital signage systems. For integrating existing system, external player PC may be accepted on case by case basis.

.5 Flat screen panel shall be of Slim line for accessibility requirements.

.3 Floor mount integrated digital signage:

.1 Commercial grade interactive accessible digital signage kiosk, where applicable.

.4 Preconfigured / preprogrammed Player PC:

.1 Player PC shall be vendor configured to insure the compatibility of the DSS with the remotely administrable configuration.

.2 Shall have at least one 1080p Display Port or HDMI output.

.3 Shall be of the most current technology with a minimum of Quad Core Processor, 3GHz, 500GB HHD @ 7200rpm or higher, 8GB RAM running Windows 10 or any other approved system by UTM IT, if required. Note: for some applications, a TV tuner may be required.

.4 Shall be compatible with campus wired network connectivity to connect back to the signage system seamlessly.

.5 Shall be capable of connecting securely through campus wireless network if required/desired.

.6 Audio requirements to be determined on a case-by-case basis.

.5 Infrastructure/Architecture:

.1 Signage connectivity requirements shall be limited to standard network connectivity and power.

.2 The endpoints shall have the option to use wireless technology for their internet or network connectivity.

.3 Standard switched network drops shall be easily repurposed if the signage is removed or a new technology is deployed and shall be all the endpoints require, avoiding the need for shielded cat5, VGA broadcaster/receivers, and other non-standard technology.

Important Note: Content of all DSS shall be governed by UTM Office of Advancement: http://www.utm.utoronto.ca/support-utm/office-advancement

3 EXECUTIONS

3.1 Installation

.1 General:

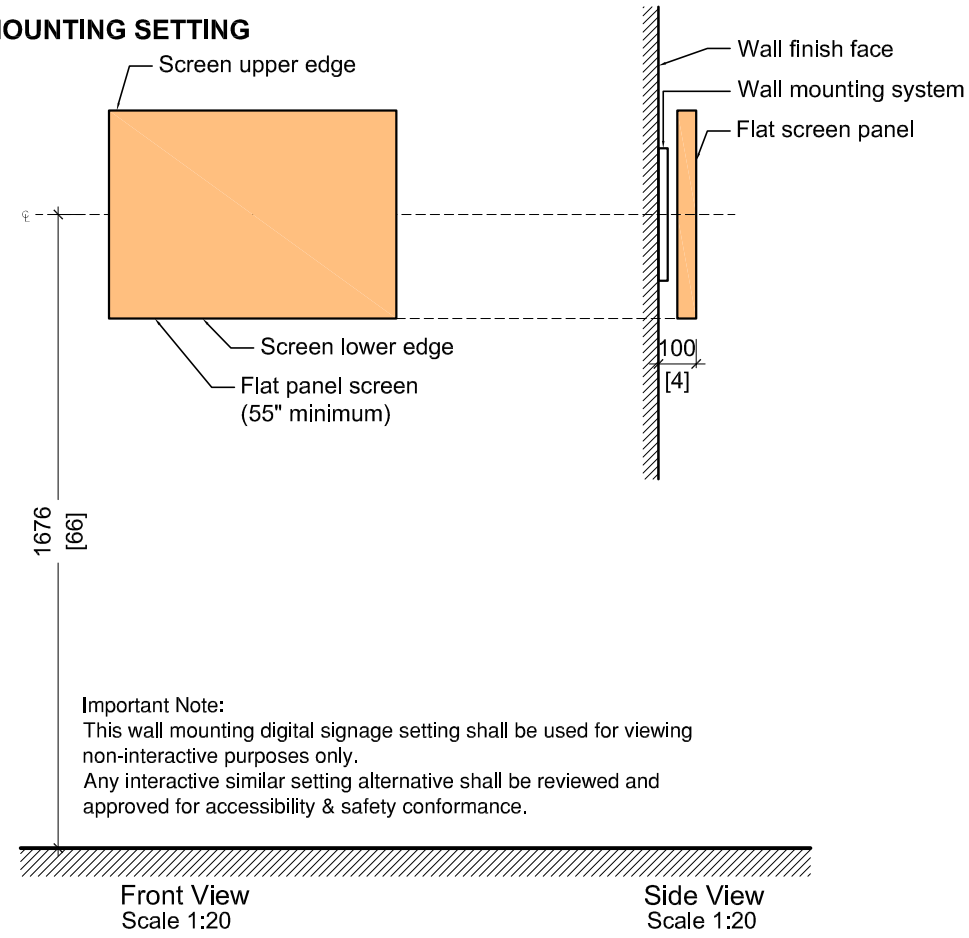
.1 Mounting locations, heights and viewing distances shall be within an accessible and easy to read range and should comply with accessibility codes as applicable taking lighting elements, traffic and viewing angles into consideration. (Please refer to layouts no. (27 42 13 –1) & (27 42 13 – 2) for more details).

.2 The DSS shall take into consideration the wall materials, strength and fire rating to ensure safe and secure mounting.

.3 The DSS shall not be mounted on thin dry wall or in areas where mounting screws or bolts protrude in a manner where they can be accessed from the rear of the unit.

END OF SECTION

A. TYPICAL WALL MOUNTING SETTING

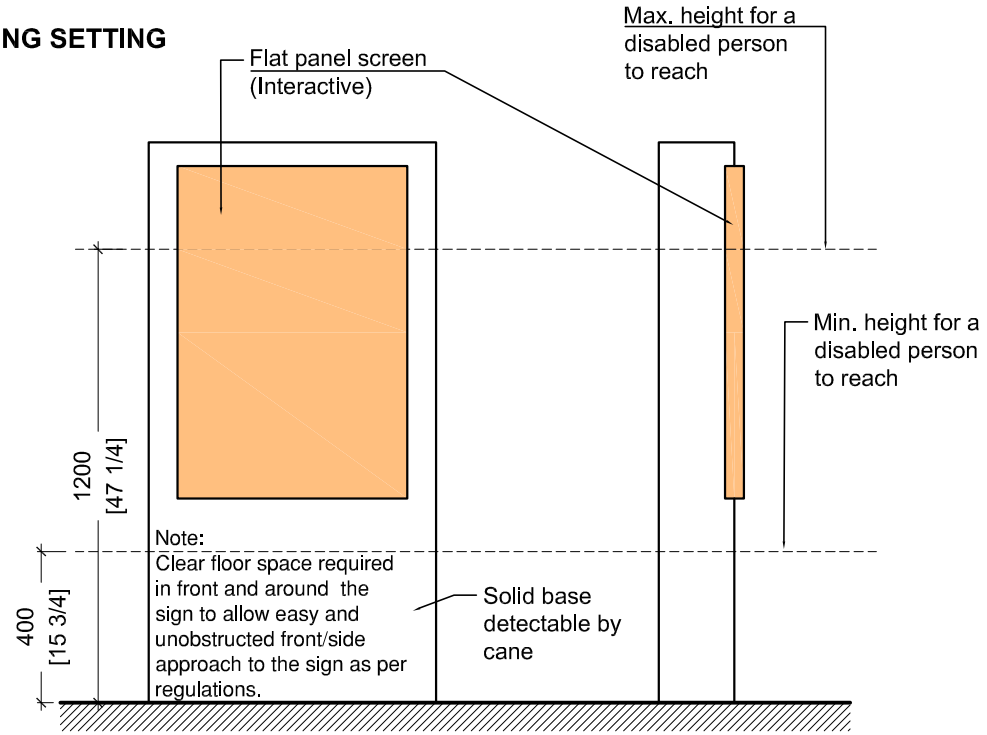


Important Note:
This wall mounting digital signage setting shall be used for viewing non-interactive purposes only.
Any interactive similar setting alternative shall be reviewed and approved for accessibility & safety conformance.

Front View
Scale 1:20

Side View
Scale 1:20

B. FLOOR MOUNTING SETTING (Interactive)



Front View
Scale 1:20

Side View
Scale 1:20

UNIVERSITY OF TORONTO MISSISSAUGA

Public Information Systems
(Digital Signage)
UTM Standards: Renovations & New Construction

DRAWING TITLE:
DSS Wall Mounting Systems (A&B)

No.	DATE	REVISION
1.	April, 2013	R 1.0
2.	February, 2014	R 1.1
3.	October, 2019	R 1.2

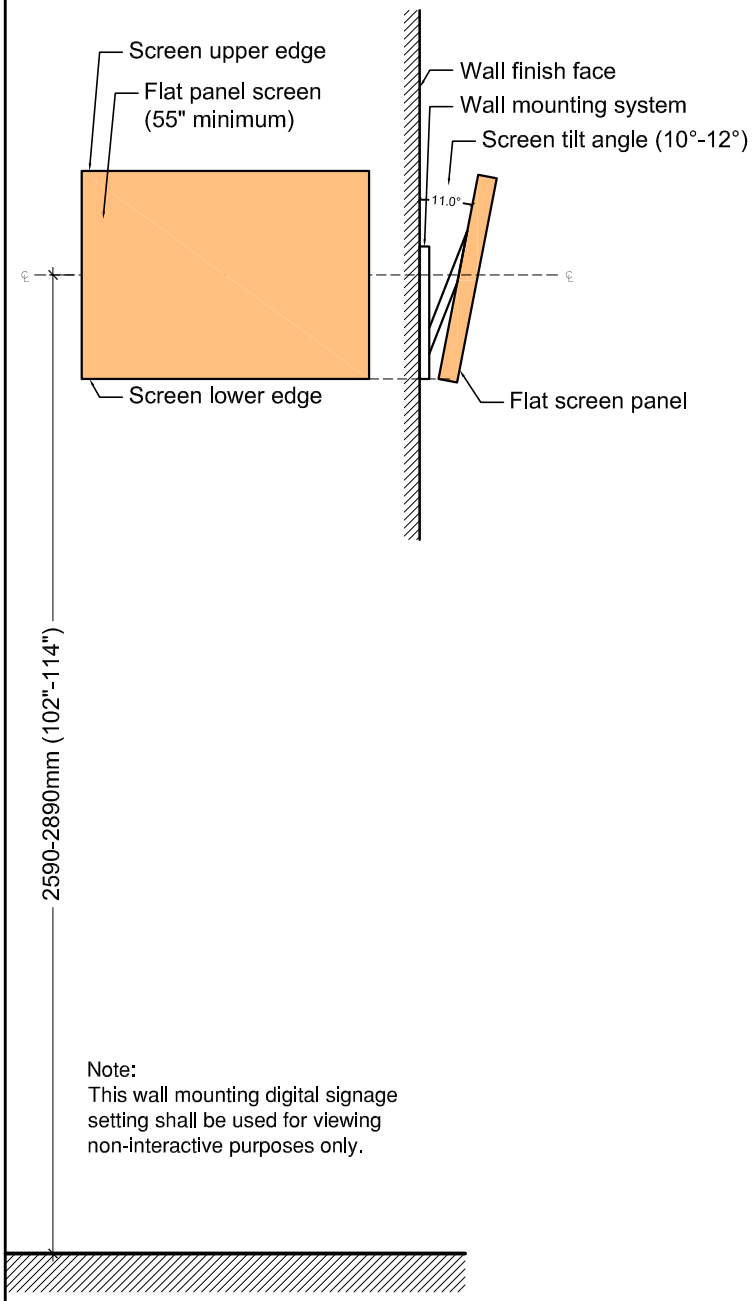
PREPARED BY: S. RASHEED

APPROVED BY:

Layout No.

27 42 13 - 1

C. ELEVATED WALL MOUNTING SETTING

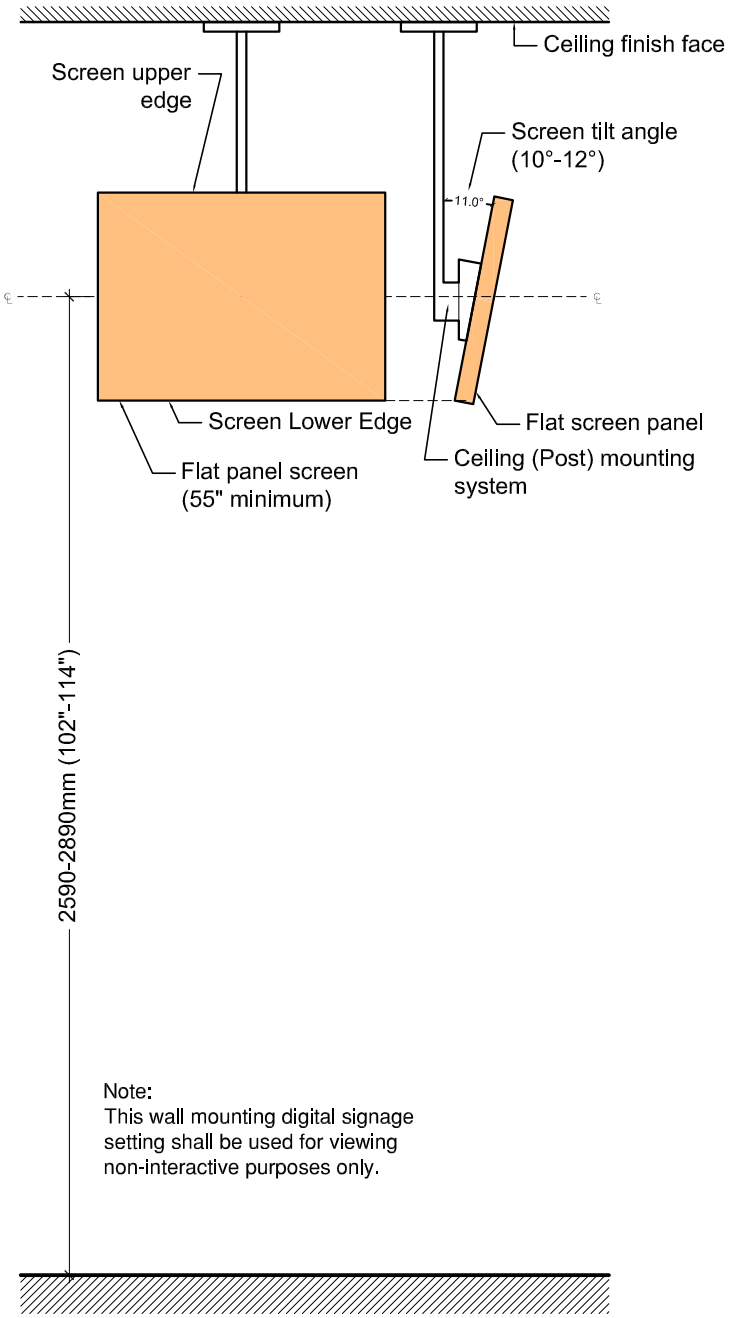


Note:
This wall mounting digital signage setting shall be used for viewing non-interactive purposes only.

Front View
Scale 1:20

Side View
Scale 1:20

D. ELEVATED CEILING MOUNTING SETTING



Note:
This wall mounting digital signage setting shall be used for viewing non-interactive purposes only.

Front View
Scale 1:20

Side View
Scale 1:20

UNIVERSITY OF TORONTO MISSISSAUGA

Public Information Systems
(Digital Signage)
UTM Standards: Renovations & New Construction

DRAWING TITLE:
DSS Wall Mounting Systems (C&D)

No.	DATE	REVISION
1.	April, 2013	R 1.0
2.	February, 2014	R 1.1
3.	October, 2019	R 1.2

PREPARED BY: S. RASHEED

APPROVED BY:

Layout No.
27 42 13 - 2

SECURITY SYSTEM
28 10 10

1 GENERAL

1.1 Work Included

.1 Comply with the General requirements and documents referred to within.

.2 Provide labour, materials, products, equipment and services to complete the access control systems and video surveillance system work specified within.

.3 Provide and test the installation of the cabling and hardware for the card access and video surveillance.

.4 The system shall include connection to architectural hardware devices and field devices as shown on the Drawings.

.5 All wiring and connection to interfacing systems, including but not limited to, door hardware and door operators shall be provided and coordinated with the appropriate contractors.

.6 The quantities of components shall be determined and installed based on the requirement to provide a complete and fully operational wiring infrastructure for card access security system, as per the intent of the specification, and as shown on the drawings and recommended by the manufacturer.

1.2 Quality Assurance

.1 All materials, equipment and parts comprising the unit's specified within this document shall be new and unused and of a current manufacture.

.2 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

1.3 Preferred Vendor

.1 The following is the preferred security vendor for the Owner of this project:

Convergint Technologies

Attn. Healey Willan, Account Executive

647-390-5159, healey.willan@convergint.com

483 Bay Street, Suite B1-08C&D, Toronto ON M5G 2C9

1.4 Submittals

.1 Shop drawings shall be submitted for each type of product indicated or equivalent in the following document.

1.5 General Configuration

.1 All hardware must have an Owner supplied key override for any security door electrically locked.

.2 All doors with the exception of overhead doors, shall report both forced open and door held unless otherwise requested by the Owner.

.3 Overhead doors requiring access control with an electronic system (i.e. Maxxess eFusion, etc.) shall be equipped with a door contact and key switch.

.4 All elevators equipped with a card reader to allow/restrict access to all floors so that they can be remotely locked down. Floor access will only be granted to a valid card holder. Floor tracking is not required.

.5 All decisions shall be controller based.

.6 Doors with automatic openers shall be interfaced so that the locking device is disengaged (unlocked)
prior to the auto door operator attempting to open the door. (Avoid motor burnout and false alarms).

.7 Provide glass break detector where there is a glass window integral in the door or surrounding glazing at Ground level. This may be removed by the client but the client must be advised in writing that failure to provide glass break protection may provide an undetected point of unlawful entry.

.8 Workstations and servers will be provided by the University where required, as will an access control service to which all new and added endpoints are attached and commissioned. Any interface with this these systems, or the database, to be done in concert with UTM Campus Police and UTM Information and Instructional Technologies personnel.

.9 The contractor shall only submit products for which they are factory authorized to sell, install and service. The contractor shall furnish all equipment, accessories and material. This shall be done in strict accordance with specifications and applicable drawings as required for a complete and working system. All material and/or equipment necessary for proper operation of the system not specified or described herein shall be deemed part of the specifications.

.10 The Owner will provide the computers to be used for workstations and the access control server.

.11 Access control server programming, testing, graphics, final commissioning, device licensing and user training to the Front End to be provided by the UTM security contractor.

.12 Provide As-built drawing in AutoCAD format indicating all cables and equipment

2 PRODUCTS

2.1 Access Control System

.1 The access control system will be a PCSC Fault Tolerant (Maxxess eFusion) system consisting of SDM (single door reader) and DDM (double reader doors) controllers and a Main Controller or approved equivalent by UTM Campus Police Services.

.2 Fault-tolerant (FT) Main Controller

.1 Automatic hot cutover

.2 fail safe operations

.3 open system platform

.4 open architecture protocol

.5 Ethernet/PoE communication

.6 peer to peer communications

.7 auto alternate communication routing

.8 access action for disabled persons

.9 onboard rechargeable battery

.10 circuit user selectable input

.3 The SDM FT Controller (located at the door) has the following features:

.1 32 Bit CPU

.2 onboard PoE communication

.3 1 Weigand Reader port

.4 1 door lock form C relay output

.5 1 Rex Input

.6 1 door position input

.7 1 powered lock output

.4 The DDM FT Controller (located in a locked room) has the following features:

.1

.2 on board Ethernet communication

.3 PoE connection

.4 Flash memory

.5 3 communication ports

.6 Seven segment status display

.7 Host online notification

.8 tamper

.9 Battery charger output

.10 electronically Protected power input

.11 5 state alarm monitoring

.12 2 Weigand reader ports

.13 2 door lock form C relay outputs

.14 2 Rex Inputs

.15 2 door position inputs

.16 2 alarm shunt outputs

.17 4 voltage outputs

.18 4 sense inputs

.19 powered lock output

.5 The controllers shall be fitted with memory expansion to handle a minimum of 100,000 cardholders.

.6 Upgrade modules shall provide supervised inputs. Non-supervised input modules

shall not be used.

.7 Elevator access controls DGP's shall be PCSC IQ ELV series controllers or approved equivalent by
UTM Campus Police Services.

.8 The access control system will be a Fault Tolerant system consisting of SDM (single door reader) and
DDM (double reader doors) controllers and a Main Controller or approved equivalent by UTM Campus Police Services.

2.2 Card Readers

.1 Card Readers, where wall mounted, shall be HID - RMP40 multiCLASS Magnetic Stripe with Prox or approved equivalent by UTM Campus Police Services.

.2 The access control system will be a Fault Tolerant system consisting of SDM (single door reader) and
DDM (double reader doors) controllers and a Main Controller or approved equivalent.

.1 Data connectivity shall be provided by the University where required, and any patching, commissioning, or other interface with the University network to be done in concert with UTM Campus Police UTM Information and Instructional Technologies personnel.

.3 Doors surrounded by glazing shall have mullion mounted card readers.

.4 When the door is in both "Door Held Open" and "Door Forced Open" alarm conditions should display and alert UTM Campus Police Services.

2.3 Request-to-Exit (REX) Devices

.1 Request to exit shall be in the handle or push bar of the lock or above the secure side of the door if electric strike is required, or as indicated on the door hardware schedule.

.2 REX motion detectors shall be passive infrared technology and equipped with an adjustable relay timer, a cover tamper switch and an adjustable vertical and horizontal area of detection.

.3 REX motion detectors shall be Kantech T-Rex model #T.REX-LT or approved equivalent.

.4 REX motion detectors shall be monitored as a separate input and shall not be interconnected to the door contacts to be bypassed so that the request to exit is a controller-based decision.

2.4 Door Contacts (Person Doors)

.1 Door contacts shall be Sentrol 1078T 1" door contact or approved equivalent.

.2 All door contacts shall be concealed unless otherwise approved by the consultant.

.3 Door contacts shall be of a colour to match the colour of the doorframe.

2.5 Motion Detection (Interior Area Protection)

.1 Motion detectors shall be dual technology consisting of both passive infrared and microwave technologies and shall be Honeywell Dual Tec Series detectors or approved.

.2 Detector model maximum coverage area shall be suitable to cover intended area unless otherwise specified.

2.6 Glass Break Detectors

.1 Glass break detectors shall be acoustic technology with a maximum range of 15 feet and shall be Honeywell FG-1625 Glass break or approved equivalent.

.2 Glass break detectors shall be tested and approved for installation with 3M security window film.

.3 Glass break detectors shall be mounted between 10 feet to 12 feet from the windows they are intended to protect.

2.7 Electrified Locking Devices (Door Hardware)

.1 Electric strikes shall be Assa Abloy HES 1600, or approved equivalent.

.2 All electrified locking devices shall be fail-secure devices and shall be wired in a fail-secure manner during a panel and/or power failure.

.3 When using the FT SDM, lock status is not monitored. With the approval of Owner, in high security applications, electrified locking devices shall be fitted with lock status monitors and monitored as a separate input.

.4 Doors equipped with a mechanical or electrical crash bar/panic set shall have a request to exit switch integral to the door hardware.

2.8 Closed-circuit TV (CCTV) Camera

.1 CCTV camera to be Axis P3225-V Mk II network camera, or approved equivalent.

.2 Camera to be provided with all necessary accessories and options, including housing, required for install within suspended ceiling or pendant-mount, as required and as shown based on the locations of the cameras on the Contract Drawings.

2.9 Wiring and Conduit

.1 All wiring for access control and surveillance devices is to be installed in conduit.

.1 Conduit is to be sized to meet requirements of security wiring with a maximum of 40% fill permitted. Minimum conduit size permitted for security system is 1" (27mm).

.2 Wiring to be provided by Division 26 contractor and as shown on Contract Drawings. Electrical Contractor is responsible for verifying wire types and sizes with Security Vendor prior to procurement and installation.

3 EXECUTION

3.1 Access Control Operating Scheme

.1 The access control system must be capable of performing the following tasks:

.1 Allow or deny the unlocking of a locked entrance based on criteria established in the software for individual cardholders.

.2 Record a log file of all system activity, including door access granted and denied, alarms, system messages, and data maintenance.

.3 Allow monitoring of the overall system for functionality and alarms from multiple points. System will require and record alarm acknowledgments by operator.

.4 Utilize the campus TCP/IP network for communications between controllers and the central database.

.5 Provide security of the door, even in the event communication is lost to the main database, allowing the door to continue to recognize which cards to grant access to, and continuing to record access transactions.

.6 Allow proper egress in emergency situations such that no special knowledge or card is required to exit a space.

.7 Must comply with OBC and other standards of the campus.

.8 Allow for central administration of the access control database for purposes of populating and maintaining the overall database, while allowing numerous secured users to grant or deny access for individuals from multiple workstations around the campus.

.9 Allow for unattended scheduled unlocking of individual doors for a sustained period of public access.

.10 All panels and power supplies shall have battery backup to keep the systems fully functional for a minimum of 4 hours.

3.2 Video Surveillance System

.1 Provide an Ethernet connection between camera location shown and the security system network switch or system head end.

.2 Security cabling shall be installed in conduit (minimum of 1").

.3 System supplier to coordinate and commission the closed-circuit camera system with the Owner's security vendor to integrate with the existing system.

3.3 Owner Security Contractor

.1 The Owner's security contractor will provide all access control programming, graphics, testing and final commissioning of the Access Control Systems. Security system supplier to coordinate with Owner for complete commissioning and testing of new equipment supplied under this Contract.

END OF SECTION

ADDRESSABLE FIRE ALARM SYSTEM
28 31 16

1 GENERAL

1.1 General Requirements

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.2 Acronyms

.1 SCP - Satellite Control Panel

.2 CACF - Central Alarm and Control Facility

.3 EVAC - Emergency Voice and Communication

.4 CPU - Central Processing Unit

.5 LED - Light Emitting Diode

.6 VDT - Video Display Terminal

.7 RAU - Remote Audio Unit

.8 DGP- Data Gathering Panel

1.3 Related Work

.1 Section 08710 – Door Hardware

.2 Section 26 05 19 – Wires & Cables 0-1000 Volts

.3 Section 26 05 33 – Conduits, Fastenings and Fittings

.4 Section 26 27 26 – Wiring Devices

.5 Section 26 28 16 – Moulded Case Circuit Breakers

.6 Section 26 51 13 – Lighting

1.4 References - Current Edition Of

.1 CAN/ULC-S524 Installation of Fire Alarm Systems

.2 ULC-S525 Audible Signal Appliances

.3 CAN/ULC-S527 Control Units

.4 CAN/ULC-S528 Manual Pull Stations

.5 CAN/ULC-S529 Smoke Detectors

.6 CAN/ULC-S530 Heat Actuated Fire Detectors

.7 CAN/ULC-S536 Inspection and Testing of Fire Alarm Systems

.8 CAN/ULC-S537 Verification of Fire Alarm Systems

.9 CAN/ULC-S548 Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems

.10 CAN/ULC–S533 Egress Door Securing and Releasing Devices

.11 CAN/ULC–S542 Speakers for Fire Alarm Systems

.12 CAN/ULC-S526 Visual Signal Appliances

.13 1997 Ontario Building Code and its references.

1.5 Requirements Regulatory Agencies

.1 System

.1 Ontario Building Code

.2 Ontario Electrical Safety Code C22.1-98

.2 System components: listed by ULC and CSA and complying with applicable provisions of Ontario
Building Code, and meeting requirements of the local authority having jurisdiction.

1.6 Preferred Vendor

.1 The preferred vendor for this project is Vipond Inc. Contact Dennis Weber, 905-564-7066, x470, dennis.weber@vipond.ca.

1.7 Shop Drawings

.1 Submit shop drawings in accordance with Section 26 05 01- Electrical General Requirements.

.2 Submit to Authority Having Jurisdiction, drawings showing, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.

.3 Include:

.1 Overall system riser wiring diagram identifying control unit, initiating zones, signaling circuits;
identifying terminations, terminal numbers, conductors
and raceways.

.2 Details for devices.

.3 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.4 Step-by-step operating sequence, cross referenced to logic flow diagram.

.5 Battery capacity calculation.

.4 The Contractor in co-operation with the supplier of the system shall prepare a detailed

riser diagram
of the complete system showing all major components, devices and necessary interconnecting wiring.

.1 Diagram is to indicate wiring quantities, sizes and colour code and to indicate conduit sizes.

.2 Riser Diagram is to be produced on AutoCad and is to be submitted as a Shop Drawing.

.3 Riser Diagram is to be revised 'As-Built' at the completion of the project and submitted with
Maintenance Manuals (submit both a copy of the Drawing and an AutoCad disc).

1.8 Operation and Maintenance Data

.1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 26 05 01 - Electrical General Requirements.

.2 Include:

.1 Instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

.4 List of recommended spare parts for system.

.5 Detailed maintenance instructions for control equipment and each device type, maintenance schedule in accordance with CAN/ULC-S536. Trouble shooting guide for control panels and devices.

.6 Copy of verification certificate, verification report and warranty certificates such as for fire alarm system, batteries, ancillary devices, and other similar items, including battery suppliers date coding for batteries.

.7 Name, address and telephone number of service representative of manufacturer to be contacted during warranty period.

1.9 Maintenance Materials

.1 Provide maintenance materials in accordance with Section 26 05 01 - Electrical General
Requirements.

.2 Provide following total components:

.1 Four multiplex type alarm indicating circuit modules including four isolator modules.

.2 Two multiplex type alarm supervisory circuit modules including two isolator modules.

1.10 Maintenance

.1 Provide one (1) year free maintenance with two inspections by manufacturer during first year of operation. Inspection tests to conform to ULC-S536. Submit inspection report to Engineer.

1.11 Training

.1 Provide two (2) days of on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

1.12 Work Included

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

.2 Supply and install a complete and operating single stage, zoned, addressable fully supervised microprocessor-based fire detection/alarm and integrated voice communication system as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.13 Scope of Work

.1 Establish detection loops on per zone basis on each floor of the building as indicated on drawings.

Each fire alarm zone (Floor Area) indicated on the drawings shall be a separate detection loop. Do not reduce the number of detection loops as shown on drawings.

.2 Connect new detection loop, new bell loop, and new strobe loop to existing fire alarm transponder panel in coordination with Owner's contractor.

.3 Interface fire alarm system with lighting control system to override lighting controls in event of a fire alarm condition.

.4 Interface fire alarm system with audio visual system to override audio visual systems in event of a fire alarm condition.

1.14 System Overview

.1 Each device shall be individually addressable to provide accurate identification of alarm location.

.2 All standard fire alarm input and output devices shall be hardwired or multiplexed to remote Satellite Control Panels (SCP) using remote data acquisition and control or true distributed processing techniques.

.3 Bells and strobes are to operate on separate circuits to allow for strobes to continue annunciating when bells are silenced during a fire alarm condition.

1.15 System Operation

.1 If an alarm is initiated in any area of the building by one of the following, the CPU shall initiate the alarm sequence of operations described in Item 1.15.2:

.1 operation of a manual pull station

.2 operation of an automatic fire detector

.2 Sequence of operations:

.1 A trouble inhibit circuit shall be initiated to suppress any trouble signals during an alarm

.2 Signals in the Building, shall sound an "alert" signal at 20 or 30 strokes per minute.

.3 An alarm initiated in the power plant will sound the signals at a temporal rate in the respective building and not in the rest of the building complex.

.4 Strobe signals and the zone lights in the zone or area where the alarm originated shall activate.

.5 Annunciators shall indicate exact zone where alarm originated.

.6 All fans shall be automatically turned off (except fans dedicated for emergency operation)

.7 Pressurization system fan systems shall be started up.

.8 Doors normally held open through magnetic door holders shall be released.

.9 Doors normally locked by magnetic devices shall be released

.10 Signal the elevator control panels

.11 Fire Alarm System CPU shall transmit a signal to fire department or approved central station via leased telephone lines through the CACF.

1.16 Trouble Signal Operation

.1 If a trouble signal is caused by any of the following conditions:

.1 Short, ground fault or open circuit in any fire alarm conductor, data communication cable or field device

.2 Loss of 120 V AC 60 Hz power supply to the CPU, CACF or any Satellite Control Panel

.3 Fault in the emergency voice and communication system hardware

.2 The CPU shall initiate a trouble condition sequence of operations as follows:

.1 each annunciator shall identify, as a separate supervisory zone, the item causing the signal

.2 the trouble buzzer on the annunciators shall sound

.3 the trouble condition shall be displayed on the VDT. Trouble condition shall remain on the screen until acknowledged

.3 The signals in the building shall not be sounded.

.4 A subsequent trouble signal shall re-activate the trouble alarm sequence.

.5 Alarms shall not be left with a short, open, ground fault or communication failure on the addressable line.

2 PRODUCTS

2.1 Input (Alarm Initiating) Circuits

.1 Provide alarm receiving circuits, addressable line cards for alarm initiating devices such as manual pull stations, smoke detectors, combination smoke detectors/ heat detectors (Intelligent type), heat detectors, and water flow switches as indicated on Drawings.

.2 Alarm receiving circuits shall be wired in a Class A, 2-wire configuration with the loop returning to the control panel via a separate conduit. Provide a conduit run from the

respective control panel to the first and last device on the loop.

.3 All alarm receiving circuits shall be supervised for open, short or ground fault conditions.

2.2 Output Alarm Circuits

.1 Provide alarm output circuits for polarized audible signals such as speakers, horns and visual indicators as indicated.

.2 Provide necessary amplifiers and tone generator modules for electronic audible alarm devices as required.

.3 Alarm output circuits shall be wired in a class B, 2-wire configuration.

.4 Alarm output circuits shall have the capability of being manually tested on a circuit by circuit basis by the CPU using a keypad or a keyboard.

.5 Alarm output circuits shall have the capability of being manually disconnected on a circuit by circuit basis at the CACF for testing purposes. A trouble signal shall sound when any output circuit is manually disconnected.

.6 All alarm output circuits shall be supervised for open, short or ground fault conditions by the use of an end of line resistor.

2.3 Auxiliary Circuits

.1 Provide contacts, control modules, monitor modules, addressable double voltage relays for fan shut- down and status indication as indicated on schedules and as required to make the system operate as specified. Fan bypass feature shall be provided for each group of fans as indicated, coordinate on site.

.2 Provide auxiliary contacts with 120 V AC/24 V DC, 2.5 A @ 0.5 power factor rating.

2.4 Central Alarm Control Facility (CACF)

.1 The Central Alarm Control Facility (CACF) is existing.

2.5 Annunciator Panel

.1 Annunciators are existing. Modify existing panel to include new zones to match existing layout and configuration of annunciator panel and mimic panel.

.2 Each zone shall be assigned the following:

.1 Illuminated zone indication

.2 Lamps to indicate alarm circuit has operated (red LED)

.3 Smoke detection system operation (red LED)

.4 Sprinkler flow switch operation (red LED)

.5 Supervised valve trouble indication (amber LED)

.3 The annunciator indication and control features shall be assigned to provide the following functions:

.1 Power On indicator

.2 Sprinkler trouble

.3 Sprinkler riser flow indication

.4 Standpipe valve trouble

.5 Battery power loss or trouble

.6 System trouble indication

.7 Trouble silencing switch with ring-back feature

.8 Lamp test switch

.9 System evacuation alarm key switch

2.6 Power Supply

.1 The existing power supply and battery backup shall be verified by the Contractor for sufficient capacity to support new devices, as shown on Contract Drawings.

.1 DC Power Supply for the fire alarm system shall be provided from a completely automatic battery charger and batteries forming part of the control panel.

.2 The batteries shall be sufficiently sized to operate the system under supervisory load conditions without recharging for not less than 24 consecutive hours with sufficient power remaining to operate signals for at least 2 hours.

2.7 Addressable Manual Fire Alarm Stations

.1 Manual pull stations shall be metal construction, open circuit, pull lever type and finished in red enamel. They shall be mounted in a 102 mm (4 in) square recessed box with plaster ring in finished areas and surface mounted in unfinished areas.

.2 Manual stations shall be suitable for insertion of an evacuation key.

.3 Manual stations shall create an address on identifiable loop.

.4 Each Pull station shall be provided with an additional auxiliary contact(s) to allow direct connection to future magnetic locks.

2.8 Automatic Fire Detectors (Heat Detectors)

.1 Automatic detectors shall be of the following types:

.1 135 □ F, fixed temperature and 15 □ F per minute, rate of rise

.2 200 □ F, fixed temperature only

.3 as indicated on drawings

.2 Detectors shall have suitable mounting plates with finish ring.

2.9 End of Line Resistors

.1 Where Class B wiring is specified or permitted, the end of line resistors shall be located in outlet box with stainless steel cover plate.

2.10 Smoke Detectors (Photoelectric Smoke)

.1 It shall be possible to check and change sensitivity of detectors. Smoke detectors shall be set for approved sensitivity. Detectors shall provide environmental compensation complete with "Dirty" and "Excessively Dirty" messages.

.2 The Photoelectric smoke detectors shall operate on the photoelectric (light scattering) principle of operation and be activated by visible or invisible products of combustion. Detectors shall be constructed of solid state components with the infrared light source for the photoelectric sensor emitted from a semiconductor diode.

.3 Where a heat detector component is supplied as part of the detection device, the heat detector component of the detector shall be restorable and set at 135 degrees F fixed temperature.

.4 Detectors shall be ULC listed.

.5 Incorporate an LED or lamp latched circuit to indicate the signal operation of the unit.

.6 Smoke detectors shall operate on 24 volts DC and be protected against electrical transients and electromagnetic interference.

.7 Detectors shall be equipped with NO/NC contacts to operate ancillary devices, where applicable.

.8 Detectors shall be equipped with a fine mesh bug screen to prevent contamination of the detection chamber by insects.

.9 Recessed smoke detector shall be complete with necessary shroud and flush mounting hardware.

.10 Protect automatic smoke detectors during construction with a dust-bag, which shall be removed at the time of verification.

.11 Provide standard type non-addressable devices in unheated areas with individual control modules mounted in a heated part of the building.

2.11 Duct Mounted Smoke Detectors

.1 Duct-mounted smoke detectors shall consist of a photoelectric type smoke detector as described above, and an air tight housing assembly, mounted on the side of the duct complete with sampling tubes and supporting framework.

.2 While fans are running, a continuous cross-sectional sampling of the air flows from the ventilation duct, through the detector, and then returned to the duct. Air stream velocity range from 2.5 m/sec minimum to 18 m/sec maximum be made to monitor, test and reset the detectors under actual air flow conditions. Unit shall be equipped with a test key switch and a reset key switch.

.3 Remote alarm lamps or LED shall indicate the signal operation of the detector. Install remote LED in an easily visible location to someone standing on the floor without requiring the use of ladders to see it.

.4 Protect automatic smoke detectors during construction with a dust-bag, which will be removed at the time of verification.

.5 Manufacturer shall include site visits to direct detailed locations of duct-mounted smoke detectors.

2.12 Addressable Bases

.1 Bases for all stations shall incorporate an addressable element, located in the base, to identify exact location of device. Detector heads for smoke or heat shall be interchangeable and can be removed without interrupting alarm processing of addressable initiating circuit/line.

2.13 Peripheral Alarm Initiating Devices

.1 Local control panels, interfaced with other equipment such as pre-action systems or other control panels, shall be a single zone capable of operating on 120 volt AC, 60 Hz and shall be complete with two isolated Form 'C' contacts and capability to initiate a fire alarm signal.

.2 Manufacturer shall examine Drawings and Specifications prior to award of Contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

2.14 Alarm Signal Appliances

.1 Remote alarm lamps shall be mounted in a single gang switch box with a brushed stainless steel cover, screw type terminals and electrically connected to heat or smoke detectors that require remote annunciation. Use only high intensity (200 med) LED lamps.

.2 Alarm strobe lamps shall be ULC listed and operate on 24 V DC. The strobe shall be able to flash at a rate of one flash per second in alarm mode. The words "FIRE" shall appear on the strobe lens. Strobes shall comply with ADA requirements.

2.15 Alarm Bells

.1 Bells are to be 10" diameter, low operating current audible signaling devices. They shall be mounted with a weatherproof gland connection capable of 97 dB at 3048 mm (10 ft).

.2 Alarm signal bells shall be supplied in fire alarm red. Arrange for speaker wiring to be supervised.
Not more than 80% of full complement of speakers shall be connected to one signal circuit.

2.16 Riser Diagram

.1 The contractor in co-operation with the supplier shall prepare a riser diagram showing all major system components and inter-connecting wiring requirements. Riser to be submitted as a shop drawing.

2.17 Wiring

.1 Wiring shall be as recommended by fire alarm system manufacturer.

.2 Wiring for speaker circuits shall be twisted pair shielded sized as recommended by the manufacturer and it shall be installed in conduit.

.3 Wiring for annunciators shall be solid copper two hour rated, serial link communication conductor as recommended by the manufacturer.

.4 Wiring between CACF or DGP / SCP / transponder to each floor's alarm input, speaker output and/or strobe output circuit shall be two-hour fire rated MICC cables.

.5 Wiring within the floor area from detection device to device shall be as recommended by manufacturer, and installed in surface mounted EMT conduit. Conduit to be concealed where possible.

.6 Providing line isolators when crossing a different fire alarm zone or fire-rated wall.

2.18 Materials

.1 Fire alarm systems and components shall be:

Standard of Acceptance
- Notifier by Honeywell

3 EXECUTION

3.1 Installation

.1 Installation of the Fire Alarm system components shall be in accordance with latest edition and all amendments of CAN/ULC-S524 Standard for the Installation of Fire Alarm Systems.

.2 Wire alarm initiating, alarm output, auxiliary output and signal devices to local SCP's as indicated in the schedules.

.3 Wire alarm initiating circuits. Connect detectors and manual stations. Properly arrange and connect circuit wiring to their respective circuits as shown on the drawings.

.4 Provide a separate class A addressable Loop for each zone as indicated on the drawings, complete with line isolators where the loop enter the zone.

.5 Connect the addressable pull stations, intelligent smoke detectors, flow switches, valves, zone alarm modules etc. to the addressable loops.

.6 Install wiring for the alarm signal, alarm initiating, fire fighter's telephone and speaker circuits in separate raceways.

.7 Wire signal circuits alternatively such that no two adjacent signal devices are on the same circuit.

.8 Arrange wiring to the speakers such that no two adjacent speakers are connected to the same circuit.

.9 Speakers and/or horns shall be surface mounted in stairwells and equipment spaces.

.10 Equip all raceways with a separate ground conductor and connect to ground bus in the Central Alarm

Control Facility or local Satellite Control Panel.

.11 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the signals or by ringing it out. Test each smoke detector, annunciator, sprinkler system and standpipe system valves to ensure correct wiring.

3.2 Auxiliary System Interfaces / Connections

.1 Provide two (2) output signal circuit to the lighting controller. Output is to trigger on fire alarm only and is to engage the lighting control system to override any local lighting controls (i.e. dimming, vacancy sensors, etc).

.2 Provide four (4) output signal circuits to the receptacle power panel. Outputs are to be rated at 120
V, 15 Amp. These outputs are to trigger on fire alarm only, and are to engage the shunt trip on separate circuit breakers to cut power to the AV systems throughout the project.

3.3 Wiring

.1 Install wiring in conduit using wire size and type in accordance with manufacturer's recommendations.

.2 Connect automatic detectors, smoke detectors and manual stations between red and black conductors at each outlet. Cut red and black conductors at each outlet and connect to terminal screws provided, red to red and black to black.

.3 Align alarm devices and signals, where grouped together, one above the other.

.4 Install wiring between fire alarm annunciator and each diesel-generator control panel to show
"running" and "trouble" indications.

.5 Arrange wiring between and new fire alarm control system to achieve operation as specified.

.6 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.

3.4 System Verification

.1 The fire alarm system shall be verified in accordance to ULC CAN 4-S537 Standard for the
Verification of Fire Alarm Systems.

.2 The manufacturer of the fire alarm and voice communication system shall make a complete inspection of all components installed for system, such as manual stations, speakers, smoke detectors, annunciators, sprinkler and standpipe valves to ensure the following:

.1 That the system is complete in accordance with Specifications.

.2 That the system is connected in accordance with Manufacturer's recommendations.

.3 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves) and are properly wired and supervised.

.4 That all equipment as part of the system is inspected for visible damage or tampering which might interfere with its intended operation.

.5 That adjacent speakers have been connected to alternate circuits.

.6 That all valves are properly connected and displayed correctly on each annunciator.

.7 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.

.8 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.

.9 That all sprinkler system and standpipe system valves have been operated and are in good working order.

.10 That all annunciators correctly pin-point the origin of any fire alarm.

.11 That actual smoke concentrations of sufficient density, have been applied to each new smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set. On completion of test, a letter shall be forwarded stating that tests have been completed and that system is operating correctly.

.12 All tests required by Local Authorities have been carried out and all zones have been verified.

.3 Verification records shall be maintained with the following minimum requirements:

.1 verification records shall list each device and show the date on which each device was verified and the initials of the person who verified it.

.2 verification records shall show the date on which all devices were verified.

.3 verification records shall show the date of all deficiencies encountered in the control equipment, wiring and field devices.

.4 verification records shall show the date when deficiencies were corrected and re-verified

.4 Provide any necessary equipment, test apparatus, ladders and scaffolding as required.

.5 Adjust system and components as required to ensure complete system operation.

.6 Only after the testing and verification task is completed, and all deficiencies rectified, notify the Engineers and representatives of the Fire Department and demonstrate the proper functioning of the system.

.7 The system shall be capable of being reprogrammed when all the devices are finally installed.

.8 Where partial occupancies occur, the fire alarm system for the area to be occupied (including control units, annunciators, etc..) shall be tested and meet the requirements noted above. Upon system completion, those parts of the fire alarm system tested to this specification shall be retested in accordance with the requirements of CAN/ULC-S536, Standard for the Inspection and Testing of Fire

Alarm Systems and as required by Local Authorities.

3.5 Warranty for Equipment and Installation

.1 Provide a two (2) year full warranty for service and installation of the system for a period of two years beginning upon acceptance of the completed project.

.2 Include a complete test and inspection at the end of the two years in accordance with the requirements of CAN/ULC-S536 "Standard for the inspection and testing of fire alarm systems."

.3 Replace any defective components as the result of the test inspection.

3.6 Spare Components

.1 Contractor to carry the cost of providing three (3) horn/strobes that are in addition to the quantity shown on the Contract Drawings, including a minimum of 25 ft conduit and wiring per spare, as well as device testing and verification. Owner may elect to substitute a spare horn or spare strobe instead of a spare combination horn/strobe at no additional cost.

.2 Contractor to carry cost of providing three (3) additional control modules (CM) that are in addition to the quantity shown on the Contract Drawings, including a minimum of 25 ft conduit and wiring per spare, as well as device testing and verification. Owner may elect to substitute a spare monitoring module (MM) instead of a spare CM at no additional cost.

.3 Contractor to carry cost of providing four (4) additional fire detectors (either smoke-type or heat-type) that are in addition to the quantity shown on the Contract Drawings, including a minimum of 25 ft conduit and wiring per spare per spare, as well as device testing and verification.

.4 Contractor to carry cost of providing two (2) additional manual pull stations that are in addition to the quantity shown on the Contract Drawings, including a minimum of 25 ft conduit and wiring per spare, as well as device testing and verification.

END OF SECTION

1.0 GENERAL

1.1 Work Included

.1 Preparation of existing subgrade material and installation of new granular backfill material.

1.2 References

.1 All referenced Standards are latest editions referenced by the Building Code in the Place of the Work, or latest editions if not referenced by Code.

.2 Ontario Building Code

.3	ASTM C117	Standard Test Method for Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
.4	ASTM C136/136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
.5	CAN/CGSB-8.1-88	Sieves, Testing, Woven Wire, Inch Series (Withdrawn)
.6	CAN/CGSB-8.2-M88	Sieves, Testing, Woven Wire, Metric Series (Withdrawn)
.7	OPSS 501	Compacting
.8	OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

1.3 Submittals

.1 Obtain certificates from suppliers that attest that supplied materials comply with Specifications and submit to Consultant.

.2 Obtain copies of waybills for supplied granular backfill material and submit to Consultant at end of each workday.

.3 Unit weight of supplied materials will be determined by average of three compaction tests conducted in the field or by using minimum specified weights and volume based on measured areas.

2.0 PRODUCTS

2.1 Materials

.1 Gradations to be within specified limits when tested to ASTM C117 and ASTM C136/136M. Sieve sizes to CAN/CGSB-8.1 and/or CAN/CGSB-8.2.

.2 Crushed stone or gravel shall consist of hard, durable, angular particles that are free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.

.3 Filter fabric to be suitable for intended use, as confirmed by Consultant.

3.0 EXECUTION

3.1 Surface Preparation Prior to Installation of New Material

.1 Verify grade of items set in work area for conformance with required elevations before placing granular material. Prepare and compact subgrade prior to placing granular backfill material.

.2 Allow for Consultant review of subgrade before placing granular backfill material.

.3 Place granular backfill material only on clean unfrozen subgrade and backfill material that is free from snow and ice.

.4 Place granular backfill material to compacted thicknesses indicated in Contract Documents. Do not place frozen material.

.5 Finished base surface to be within 10 mm of specified grade but not uniformly high or low. Where grades are not specified on Drawings, confirm requirements with Consultant and ensure slopes to drain.

.6 Replace all damaged, deteriorated, and unsuitable sections of existing subgrade prior to placement of granular backfill material.

END OF SECTION