

UNIVERSITY OF TORONTO

MISSISSAUGA

SPECIFICATIONS FOR

HSC 419A, 420, 421A ANT LAB RENO
TERRENCE DONNELLY HEALTH SCIENCES COMPLEX

3359 MISSISSAUGA RD.
MISSISSAUGA, ONTARIO
UNIVERSITY PROJECT NUMBER: P300-23-095

ISSUED FOR TENDER

JUNE 6, 2024

V+A ARCHITECTS

18 HOOK AVE., UNIT 201 TORONTO, ON M6J 1T4

LORING

CONSULTING ENGINEERS
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END OFSECTION

1.01 WORK OF THE PROJECT

- .1 *Work of the Project*, of which *Work* of this *Contract* is a part, comprises the following:
 - .1 Renovation on the fourth floor of the Terrence Donnelly Health Science Complex at the University of Toronto Mississauga to create a new laboratory space in room DV5015.
 - .2 The new laboratory is a Wet Research Lab Containment Level 2 (CL2).

1.02 WORK OF THIS CONTRACT

- .1 *Work* of this *Contract* comprises the following:
 - HSC 419A, 421, 421A ANT Lab Reno
- .2 Municipal Address: University of Toronto Mississauga
W.G. Davis Building
3359 Mississauga Road, Mississauga ON L5L 1C6
- .3 Legal Description: PIN:13381-1202 LT

1.03 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*.

1.04 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".

1.05 CONTRACT DOCUMENTS FOR CONSTRUCTION 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.

1.06 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 or 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 Approved Building Permit documents issued by the City of Mississauga.

1.07 CONTRACTOR'S USE OF PREMISES

- .1 Except as otherwise specified, *Contractor* has unrestricted use of *Place of the Work* from time of *Contract* award until *Ready-for-Takeover*. Refer to Section 01 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*.

1.08 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.
 - .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 Lab equipment where noted on Drawings.

END OF SECTION

1.01 RESTRICTIONS ON USE OF PREMISES

- .1 Limit use of premises for *Work*, for storage, and for access, to allow;
 - .1 *Owner* occupancy.
- .2 Coordinate use of premises under direction of *Owner*.

1.02 OWNER OCCUPANCY

- .1 *Owner* will occupy premises during entire construction period.
- .2 Cooperate with *Owner* in scheduling operations to minimize disruptions and to facilitate *Owner* usage.

1.03 PARTIAL OWNER OCCUPANCY

- .1 Schedule designated portions of *Work* for *Owner's* use prior to Ready-for-Takeover.
- .2 *Owner* will occupy designated areas for purpose of installation of equipment.

1.04 RESTRICTED HOURS OF WORK IN OCCUPIED FACILITIES

- .1 Work shall be performed between 7:00 a.m. and 5:00 p.m.
- .2 Contractors may start at 6:00 AM only when approved by the *Owner*.
- .3 Allow for hours of work restrictions in construction progress schedule.

1.05 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 10 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 procedures.

1.06 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.

END OF SECTION

1.01 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.

1.02 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.

1.03 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

1.01 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.

1.02 SCHEDULE OF EQUIPMENT RATES

- .1 Prior to the first application for payment, submit for the Consultant's review a schedule of equipment rates for Contractor owned Construction Equipment.
- .2 Equipment rates shall reflect the 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 Equipment rates stated in the schedule shall be consistent with local equipment rental market rates and shall not include any additional overhead and profit component.
- .4 Obtain the Owner's written acceptance of the schedule of equipment rates before submitting the first Change Order quotation.
- .5 Accepted schedule of equipment rates will be used solely for evaluating Change Order quotations and cost of performing work attributable to Change Directives.
- .6 The Contractor may request amendments to the accepted schedule of equipment rates if changes in local equipment rental market rates can be demonstrated. Obtain the Owner's written acceptance of such changes.

1.03 VALUATION OF CHANGES BASED ON AGREED UNIT PRICES

- .1 The Consultant may, at the outset of the Contract or at any other time, request the Contractor to submit unit prices anticipated to be required in valuing changes in the Work.
- .2 The Contractor shall submit such unit prices promptly upon request.
- .3 The unit prices shall be valid for a specified duration.
- .4 The unit prices shall exclude all fees for overhead and profit and shall be subject to the percentage fees specified in this Section under Fees for Overhead and Profit – Change Orders.
- .5 The Consultant will evaluate the Contractor's quoted unit prices and, if accepted by the Owner in writing, the agreed unit prices shall be used to value subsequent proposed changes in the Work wherever they are applicable.

1.04 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.

1.05 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:
 - .2
- .2 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 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.

1.06 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 as defined in the *Supplemental Conditions* of the contract
- .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.

1.07 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.

1.08 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.

1.09 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 defined in the *Supplemental Conditions*.
- .2 A Subcontractor's entitlement to a fee for overhead and profit on the Subcontractor's expenditures and savings attributable to a Change Directive shall be as follows, as defined in the *Supplemental Conditions*.
- .3 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.
- .4 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.

1.10 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

1.01 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 that is sufficiently detailed and comprehensive to facilitate *Consultant's* evaluation of applications for payment at an appropriate level of detail.
 - .3 Include a line items for Close Out documents equally to not less than 2.5% of the *Contract Price*.
 - .4 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*.
 - .5 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 *Contractor'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.

1.02 CASH FLOW PROJECTION

- .1 Prior to the first application for payment submit, for *Consultant's* review, a forecast of approximate monthly progress payments for each month of the *Contract Time*.
- .2 Submit revised cash flow forecasts when required due to significant changes in rate of progress of the *Work* or significant changes in the *Contract Price*.

1.03 WORKERS' COMPENSATION CLEARANCE

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

1.04 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.

1.05 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*, subject to:

- .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.

1.06 RELEASE OF HOLDBACK

- .1 Subject to the requirements of any Payment Legislation, all statutory holdback amounts shall become due and payable to the Contractor no later than 10 Working Days following the expiration of the holdback period stipulated in the lien legislation applicable to the Place of Work.

END OF SECTION

1.01 CONSTRUCTION START-UP MEETING

- .1 Promptly after *Contract* award, *Consultant*, *Contractor* and *Owner* establish the time for a construction start-up meeting to review and discuss administrative procedures and responsibilities. The meeting may be hosted on-line or in-person at the *Owner's* discretion.
- .2 Senior representatives of *Owner*, *Consultant*, subconsultants, and *Contractor*, including *Contractor's* project manager and site superintendent, shall be in attendance.
- .3 *Owner's* representative will chair the meeting and record and distribute the minutes.
- .4 Agenda will include following:
 - .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.
 - .6 Owner-supplied Products.
 - .7 Work restrictions.
 - .8 Cash allowances.
 - .9 Substitution procedures.
 - .10 *Contract* modification procedures.
 - .11 Payment procedures.
 - .12 Construction progress meetings.
 - .13 Construction progress schedule, including long lead time items.
 - .14 Submittals schedule and procedures.
 - .15 Manufacturer's Field Review.
 - .16 Quality requirements, including testing and inspection procedures.
 - .17 *Contractor's* mobilization.
 - .18 Temporary utilities.
 - .19 Existing utility services.
 - .20 Construction facilities.
 - .21 Temporary barriers and enclosures.
 - .22 Temporary controls.
 - .23 Field engineering and layout of work.
 - .24 Site safety.
 - .25 Site security.
 - .26 Cleaning and waste management.
 - .27 Closeout procedures and submittals.
 - .28 Commissioning.
 - .29 Other items.

1.02 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. Meetings may be hosted on-line with *Owner's* approval.
- .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 five 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 Approval of minutes of previous meeting.
 - .2 Work progress since previous meeting.
 - .3 Field observations, including any problems, difficulties, or concerns.
 - .4 Construction progress schedule.

- .5 Submittals schedule.
- .6 Proposed changes in the *Work*.
- .7 Requests for information.
- .8 Site safety issues.
- .9 Other business.

END OF SECTION

1.01 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.

1.02 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, *Owner* decisions for cash allowances, 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 Indicate milestone dates for Ready-for-Takeover and Substantial Performance of the Work.
 - .4 Provide a three week look ahead schedule, indicating sound levels - form to be provided by *Owner*.
- .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 10 *Working Days* after receipt.
 - .4 If changes are required, resubmit finalized initial schedule within 10 *Working Days* after return of review copy.
 - .5 Submit updated progress schedule monthly to *Owner* and *Consultant*, indicating actual and projected start and finish dates with report date line and progress, critical path and baseline comparison to current progress.

1.03 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.

1.04 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.

1.05 PROGRESS PHOTOGRAPHS

- .1 Arrange for periodic 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

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

1.02 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 10 *Working Days* for *Consultant's* review of each submittal and incorporate in submittals schedule specified in Section 01 32 00 – Construction Progress Documentation. Allow additional 5 *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*.

1.03 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

1.01 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 AA - Aluminum Association
 - .2 ANSI - American National Standards Institute
 - .3 ASME - American Society of Mechanical Engineers
 - .4 ASTM - American Society for Testing and Materials
 - .5 AWMAC - Architectural Woodwork Manufacturers Association of Canada
 - .6 CaGBC - Canadian Green Building Council
 - .7 CGSB - Canadian General Standards Board
 - .8 CSA - Canadian Standards Association
 - .9 CSSBI - Canadian Sheet Steel Building Institute
 - .10 CWB – Canadian Welding Bureau
 - .11 ICEA - Insulated Cable Engineers Association
 - .12 IEEE - Institute of Electrical and Electronics Engineers
 - .13 MPP – Master Painters Institute
 - .14 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
 - .15 NAAMM - National Association of Architectural Metal Manufacturers
 - .16 NEMA - National Electrical Manufacturers Association
 - .17 NFPA - National Fire Protection Association
 - .18 SSPC – The Society for Protective Coatings
 - .19 TTMAC - Terrazzo, Tile and Marble Association of Canada
 - .20 ULC - Underwriters' Laboratories of Canada

1.02 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*.

1.03 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*.

1.04 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

1.01 TEMPORARY UTILITIES - GENERAL

- .1 Provide temporary utilities as specified and as otherwise necessary to perform the *Work* expeditiously.
- .2 Remove temporary utilities after use.
- .3 Existing building heating, ventilation, power, and lighting may be relied upon and used during construction.
- .4 Coordinate and make arrangements with the building operator for provision of these services during hours or days when the building is not operational.

1.02 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.

1.03 TEMPORARY HEATING AND VENTILATION

- .1 Arrange and pay for temporary heating and ventilation required during construction.
- .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. Usage at no cost to *Contractor*.
- .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.

1.04 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.

1.05 EXISTING BUILDING HEATING, VENTILATION, POWER, AND LIGHTING

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

END OF SECTION

1.01 CONSTRUCTION FACILITIES - GENERAL

- .1 Provide temporary construction facilities as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.
- .2 Maintain temporary construction facilities in good condition for the duration of the *Work*.
- .3 Remove temporary construction facilities from *Place of the Work* when no longer required.

1.02 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.

1.03 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.

1.04 SANITARY FACILITIES

- .1 Existing washrooms in the building may be used by the Contractor.
- .2 Keep sanitary facilities clean.

1.05 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.

1.06 ELEVATORS

- .1 Only designated elevators may be used by construction personnel and for transporting *Products* during limited hours and days. Coordinate 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).

1.07 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

1.01 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.

1.02 DUST TIGHT PARTITIONS

- .1 Provide dust tight steel stud and gypsum board partitions to localize interior building areas from dust and noise generating activities. Fabricate and erect screens of 3-5/8" (92mm) metal studs at 16" (450mm) O.C., with 1/2" (13mm) gypsum board on both sides with closed joints
- .2 Erect, maintain, and relocate partitions as required to facilitate construction operations and *Owner's* operational requirements.
- .3 Coordinate location of dust tight partitions, screens, weather barriers and doors with the *Owner*. Obtain the *Owner* approval of installed dust tight partitions, screens, weather barriers, protective coverings and protection methods before proceeding with the *Work*.
- .4 Tape or seal between adjacent boards and provide painted finish.
- .5 Seal perimeter of cut-outs around fixtures, fittings and penetrations.
- .6 Extend screens from floor to underside of structure above unless otherwise shown, noted or approved otherwise.
- .7 Where applicable, construct screen partitions to provide required fire resistance ratings and smoke-tight separation to the approval of the authorities having jurisdiction.
- .8 Provide tacky foot mats at main entrance to the area of *Work*. Replace mats as required when they are no longer tacky.
- .9 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.
- .10 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.

1.03 FIRE ROUTES

- .1 Maintain fire access routes, including overhead clearances, for use by emergency response vehicles.

1.04 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

1.01 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.

1.02 DUST AND PARTICULATE CONTROL

- .1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.
- .2 Execute *Work* by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.
- .3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads, interior and exterior staging areas and work to building utilities.
- .5 Use appropriate covers on vehicles hauling fine, dusty, or loose materials.

1.03 DEWATERING

- .1 Not used.

1.04 SITE DRAINAGE

- .1 Not used.

1.05 EROSION AND SEDIMENT CONTROL

- .1 Not used.

1.06 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

1.01 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.

1.02 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.

1.03 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.

1.04 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

1.01 EXISTING UTILITIES AND STRUCTURES

- .1 Promptly notify *Consultant* if concealed utilities, services, structures, or their locations differ from those indicated in *Contract Documents* or in available project information. *Consultant* will provide appropriate direction.
- .2 Record locations of maintained, re-routed and abandoned utility and service lines.

1.02 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

1.01 SUMMARY

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

1.02 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.

1.03 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.

1.04 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 spaces where high humidity levels are anticipated.
- .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.

1.05 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.

1.06 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.

1.07 LOCATION OF FIXTURES, OUTLETS AND DEVICES

- .1 Consider location of fixtures, outlets, and devices indicated on *Drawings* as approximate.
- .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.

1.08 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*.

1.09 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

1.01 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.

1.02 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.

1.03 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.

1.04 EXISTING UTILITIES

- .1 Where the *Work* involves breaking into or connecting to existing services, give *Owner* 15 business days notice for necessary interruption of mechanical or electrical services.
- .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.

1.05 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 Protect equipment, furniture and finishes from dust and debris in all occupiable areas. Cover all existing laboratory equipment with polyethylene sheet.
- .8 Do not use pneumatic or impact tools without *Consultant's* prior approval.
- .9 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.
- .10 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.
- .11 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.
- .12 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

END OF SECTION

1.01 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.

1.02 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.

1.03 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 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.
- .4 Remove waste materials and recyclables from *Place of the Work* weekly.
- .5 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.
- .6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

1.04 FINAL CLEANING

- .1 Before final cleaning, arrange a meeting at *Place of the Work* to determine the acceptable standard of cleaning. Ensure that *Owner, Consultant, Contractor* are in attendance.
- .2 Remove from *Place of the Work* surplus *Products*, waste materials, recyclables, *Temporary Work*, and *Construction Equipment* not required to perform any remaining work.
- .3 Provide professional cleaning by a qualified, established cleaning company.
- .4 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.
- .5 Re-clean as necessary areas that have been accessed by *Contractor's* workers prior to *Owner* occupancy.
- .6 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, floors and ceiling structure.
- .7 Clean and polish glass, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, epoxy countertops and all other finished surfaces, including mechanical and electrical fixtures. Replace broken, scratched or otherwise damaged glass.
- .8 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.
- .9 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens.
- .10 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.
- .11 Remove waste material and debris from crawlspaces, service shafts and other accessible concealed spaces.

1.05 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

1.01 READY-FOR-TAKEOVER

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

1.02 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.

1.03 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.

1.04 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

1.01 OPERATION AND MAINTENANCE MANUAL

- .1 Prepare a comprehensive operation and maintenance manual, in the languages 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 one hard copy set. Provide electronic copy in PDF format on USB flashdrive.

1.02 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.

1.03 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.
- .3 For each *Product* or system, include complete contact information for *Subcontractors*, *Suppliers* and manufacturers, including local sources for supplies and replacement parts.
- .4 *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.
- .5 Reviewed Shop Drawings.
- .6 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction. Include all items and approved stamped information that has been issued by the City of Mississauga.
- .7 Submit a screen capture in pdf format of the City of Mississauga's website portal indicating all inspections are completed and satisfactory.
- .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.

1.04 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.

1.05 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.
- .5 Materials & Equipment installed in the project shall reflect in the operation and maintenance manual. Any replacement or substitution shall be noted and included in the O & M manual.

1.06 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.

1.07 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*.
- .2 Submit Drawing in AutoCad format and include all External References (XREF Files) bound to the drawing and saved in USB Flash Drive.

- .3 AutoCAD drawing Layers and Line type shall conform with UTM FMP Layer and Line Type Standard (to be issued upon the start of Project execution).
- .4 A "Service & Base Plans Transmittal" (AutoCAD) shall be issued upon request on or before the Project Closure to finalized the As-built drawing for submission.

1.08 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

1.01 SUMMARY

- .1 Demonstrate and provide training to *Owner's* personnel on operation and maintenance of equipment and systems prior to scheduled date of *Ready-for-Takeover 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*.

1.02 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.

1.03 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*.

1.04 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

PART 1 – GENERAL

1.01 SUMMARY

- .1 Demolition and removal of selected non-structural portions of building.
- .2 Salvage:
 - .1 Salvaging of designated items for reuse by *Owner*.
- .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.

1.02 DEFINITIONS

- .1 Hand Demolition: systematic demolition of structures by workers using hand-held tools.
- .2 Mechanical Demolition: systematic demolition of structures using powered equipment.
- .3 Systematic Demolition: methodical dismantling of structure piece by piece usually carried out in reverse order of construction.

1.03 SUBMITTALS

- .1 Submit Plan of Action immediately after award of Contract for review by UTM.

1.04 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Work of this Section shall be performed in conformity with all applicable Municipal and Provincial regulations.
 - .2 Conform to The Occupational Health and Safety Act, and Regulation for Construction Projects.
 - .3 Conform to OBC as applicable.
 - .4 Conform to Fire Code, Regulation under Fire Marshals Act.
 - .5 Provide Temporary Facilities and Controls as required during the Demolition Work.
 - .6 Post danger signs conspicuously around property. If requested, provide a watchman for patrolling Site when work is not in progress to prevent public entering danger zone and to maintain barricades.
 - .7 Provide fire extinguishers acceptable to fire prevention authorities in locations and of type suitable to enable personnel to with fire occurring during progress of work.
 - .8 Qualifications:
 - .1 Employ for this work demolition company having 5 years Canadian experience in this type of work satisfactory to *Owner's* Designee. If requested, submit proof of experience. Provide Site administration and inspection of work for this Section.
 - .2 Use skilled personnel having substantial experience in careful removal handling and storing of regular construction components, items and equipment listed on Drawings and/or designated on Site to be re-used elsewhere on Project or stored in location required.
- .9 Pre-Demolition Meeting:
 - .1 Prior to start of work, arrange for Site meeting of all parties associated with work of this Section. Presided by *Owner*, meeting shall include *Contractor*, demolition Subcontractor, and *Consultant* as required.
 - .2 Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, inspection of construction to be demolished, methods to be used, sequence and quality control, project staffing, restrictions due to environmental protection requirements and other matters affecting demolition, to permit compliance with intent of this Section. Review and finalize demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays. Review and

- .3 finalize protection requirements.
- .3 Prior to commencement of demolition work carry out preconstruction safety audit to identify hazards and establish protocols and commitment to Workplace safety

1.05 PROJECT CONDITIONS

- .1 Demolition performed on this Project in areas which may be partially occupied. Take care and provisions for protection of workers on Site and occupants during progress of work.
- .2 Maintain Interior construction traffic routes in clean condition and Repair damage which is result of Work of this Contract.
- .3 Do not obstruct Dock Area, roads, streets, sidewalks, passageways nor place or store materials in these areas. Conduct operations with minimum interference.

1.06 SEQUENCE AND SCHEDULING

- .1 Demolish and remove Electrical Equipment & Services designated for removal on Drawing. Coordinate Disconnection and capping prior to authorizing removal with UTM Engineering.

PART 2 PRODUCTS

2.01 MATERIALS

- .1 Carefully remove, store, protect and re-install where applicable existing materials and equipment noted on *Drawings* to be retained and relocated. Relocate items to be retained and store them in areas directed by the *Owner*. In addition to items indicated on *Drawings*, *Owner* still reserves right to retain any items or materials.
- .2 Except as indicated on *Drawings* or designated on Site by *Owner*, materials forming permanent part of structure being demolished shall become property of this Section. Remove from Site.
- .3 Provide materials necessary for temporary bracing and shoring. On completion, remove temporary materials from Site.

PART 3 – EXECUTION

3.01 PREPARATION

- .1 Preliminary Survey:
 - .1 Before commencing demolition operations, examine Site and when requested, provide engineering survey to determine type of construction, condition of structure and Site conditions. Assess strength and stability of damaged or deteriorated structures.
 - .2 Assess potential effect of removal of any part or parts on the remainder of structure before such part(s) are removed.
 - .3 Assess effects of demolition on adjacent Areas and consider a need for, protection and/or bracing.
 - .4 After determining demolition methods, carefully inspect beyond those adjacent areas. List potential damage areas and photograph each for record purposes before starting work.
- .2 Protection:
 - .1 Conform to requirements of Instructions to Bidders and General Conditions.
 - .2 Do not interfere with use and activities of occupants where applicable in adjacent areas. Maintain free and safe passage to and from all Rooms & Building. Maintain integrity of existing fire exits.
 - .3 Protect existing adjacent work against damages which might occur from falling debris or other causes due to work of this Section.
 - .4 Provide, erect and maintain required platforms, lights and other protection around Demolition Area before commencing

- work. Maintain such areas free of water and debris. Maintain Temporary Lighting as noted on *drawings*.
- .5 Ensure scaffolds, ladders, equipment and other such equipment are not accessible to public. Protect or remove and dismantle at end of each day or when no longer required.
 - .6 Do not interfere with use and activities of adjacent Rooms. Maintain free and safe passage to and from Rooms and Building Dock Area.
 - .7 Where necessary to seal fire exits of adjoining or adjacent buildings, provide other exits in compliance with applicable fire safety and building regulations.
 - .8 Where demolition operations prevent normal access to adjacent rooms, provide and maintain suitable alternative access.
 - .9 If at any time safety of adjacent building areas appear to be endangered, cease operations and notify UTM Project Manager and/or Engineering. Do not resume operations until permission is granted by UTM.
 - .10 If UTM considers additional precautions are necessary to safeguard adjacent areas instructions will be issued.
 - .11 Erect and maintain Temporary HAZMAT, and other Partitions as required to prevent spread of dust, fumes and smoke to other parts of building. Upon completion, remove partitions and make good surfaces to match adjacent surfaces of building.
 - .12 Before starting demolition, ensure that required dust-tight partitions have been installed where necessary.
- .3 Restrictions
- .1 Restrict selective demolition activities in accordance with Section 01 14 00.
 - .2 Following methods of demolition will not be permitted in work of this Contract:
 - .1 Use of rapid progress failure methods (explosives).
 - .2 Mechanical method of demolition whereby wrecking is accomplished by smashing walls or floors with heavy weight suspended by cable from boom or hoist or where masonry walls are collapsed using power shovel, tractor or other mechanical contrivance.
 - .3 Existing Services
 - .1 Notify UTM Engineering to Main Valve Shut-off, should Secondary valves are not available nor do they hold. Verify that services are properly shut off before commencing associated or effected demolition. Cap all Drain Covers. Do not allow demolition debris into the drains.
 - .2 Provide and maintain both Existing and Temporary services required during demolition to satisfaction of authorities having jurisdiction, fire departments and utility companies.
 - .3 Verify prior to commencement work of this Section, that Pre Scheduled Main Valved Shut off has been carried out by UTM Engineering. Ensure Natural Gas lines are being removed by qualified tradesman in accordance with Gas Code Requirements, and in accordance with requirements of local authority having jurisdiction. Removal and disposal of other existing services and mechanical equipment shall be by respective Authorized Licensed Tradesmen.
 - .4 Before commencing Demolition, contact UTM Engineering, Project Manager & Electrical Maintenance Contractor for a site tour. Label & Tag all Panel circuits of existing lines to be removed and/or (temporarily) disconnect. Roll Electrical Power Wires at ceiling height along with Data & Telephone communications cables entering the demolition Area. Post warning signs on electrical lines and equipment which must remain energized to serve other Rooms during the demolition and Future General Contract Renovation Period.
 - .5 In event of an unexpected discovery that will halt Demolition, do no further work, and immediately report the discovery, orally and in writing to *Consultant* and the *Owner*. The *Consultant* will authorize remedial work, if any, in writing through a Change Order, and as an addition to the Contract.
 - .6 Remove Electrical Power Lines & Outlets and 347V LAT Lighting scheduled for removal as noted on *Drawings*. Roll Power lines at ceiling height within perimeter wall of demolition area.
 - .7 Remove Data and Telephone Lines & Jacks and roll Lines at ceiling height within perimeter wall of demolition area.
 - .8 Remove Gas, Air, Vacuum, RO, H&C Water and Sanitary Drain lines to extent indicated on Drawing and cap with New Appropriate valves to prevent leakage and future re connections.

3.02 PERFORMANCE

- .1 General
 - .1 Demolition action plans may indicate only general scope of work to be demolished and removed. It is Contractor's sole responsibility to determine exact extent of demolition required. Contractor may not rely solely on *Drawings* to limit scope of selective demolition work required. Review Site conditions and assess exact conditions & scope of demolition and removal.
 - .2 Materials and debris shall not be stacked in building to extent that overloading of any part of structure will occur.
 - .3 At end of each day's work leave work in safe condition ensuring that no parts of structure are in danger of collapsing.
- .2 Demolition
 - .1 Ensure demolition work is supervised by Trades licensed to practice in Province of Ontario at all times.
 - .2 Carry out Demolition in accordance with requirements of CSA S350-M. Demolish walls and ceiling systems c/w lights and Air grilles only, and remove materials from Site. Demolition shall be by hand tools only. Pneumatic or Hydraulic equipment may only be used outside regular working hours and must be scheduled and approved a minimum 24hrs in advance of use. Adhere to manufacturer's recommendations in use of all hand held tools while conforming to the Occupational Health and Safety Act requirements. Do not create falling materials hazard.
 - .3 Remove all mechanical and electrical items indicated to be removed.
 - .4 Demolition shall proceed safely in systematic manner from Ceiling to Floor, as noted and specified, and as necessary to accommodate future remedial work indicated.
 - .5 Demolish Interior masonry walls in small sections. Remove and lower heavy objects with safe and suitable equipment.
 - .6 Demolish and remove interior Metal Stud & Drywall Partition Walls, ceilings, and (HAZMAT) VAT flooring down to concrete substrate, unless specified and/or indicated to remain.
 - .7 Keep work wetted down to minimize dust.
 - .8 Minimize noise. Avoid use of noisy machinery outside working hours.
 - .9 Provide protection around open Floor Trenches and/or roof openings.
 - .10 Upon completion of demolition work, level and clear Site or prevent access by means of locked doors and/or hoardings.
 - .11 Firestopping and Smoke Seal: In event that work of this Section impacts on integrity of fire separations, ensure that trade performing fire stopping is notified. Perform work to suit approved ULC design and acceptable to authorities having jurisdiction.

3.03 DISPOSAL OF WASTE MATERIALS

- .1 Clear away dirt, rubbish, and loose litter resulting from the work of this Section, minimum daily. Control dust to a minimum, and install temporary dust filters on all R/A ducting serving the demolition area. When necessary and practical demolition works shall be sprayed periodically with water to reduce dust. Wet down debris from time to time to control dust. Maintain Building corridors and Dock Bin Area Clear, Clean, & Safe.
- .2 Selling and/or burning of materials on Site are not permitted.
- .3 Conform to requirements of Municipality's Works Department regarding disposal of waste materials.
 - .1 Materials prohibited from Municipality Waste Management Facilities shall be removed from Site and dispose of at recycling companies specializing in recyclable materials.
 - .2 Excavated material including contaminated excavated material shall be removed from Site and dispose of to requirements of authorities having jurisdiction without any additional cost to the *Owner*.
 - .3 Any additional materials prohibited from waste management facilities shall be removed from Site and dispose of to requirements of authorities having jurisdiction without any additional cost the *Owner*.

3.04 FIELD QUALITY CONTROL

- .1 Engage and pay a Health & Safety Specialist registered in Province of Ontario to supervise demolition, cutting and removals of necessary work of this Section.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

- .1 Section includes:
 - .1 Labour, Products equipment and services necessary for the finish carpentry work in accordance with the Contract Documents.
 - .2 Finish carpentry in the Clean lab #421.
 - .3 Chemically resistant plastic-laminate-clad architecture cabinets.
 - .4 Cabinet hardware and accessories.
 - .5 Blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.02 SUBMITTALS

- .1 *Shop Drawings*: Submit *Shop Drawings* for work of this Section in accordance with Section 01 30 00. In addition to minimum requirements indicate following:
 - .1 Materials, thicknesses, sizes, finishes, wood species, grades, profiles, connection attachments, shop jointing, field jointing, cutout locations, and sizes.
 - .2 Include erection drawings, plans, elevations, sections, and details as applicable.
- .2 Samples: Submit samples of the following in accordance with Section 01 30 00:
 - .1 Two of each colour, pattern, gloss, and texture of plastic laminate, in manufacturer's standard tag size.
 - .2 Two samples of laminated plastic joints, edging, cutouts, post formed profiles and cabinet pulls.

1.03 QUALITY ASSURANCE

- .1 Execute work of this Section by member of AWMAC, with 5 years experience in finish carpentry work of comparable complexity and scope. Submit proof of experience upon Consultant's request.
- .2 Fabricate finish carpentry work in accordance with AWS Quality Standards, Premium Quality materials and installation unless otherwise indicated. Perform work in accordance with the definition of Good Workmanship as defined in the AWS Quality Standards.
- .3 Remove and replace finish carpentry work which does not conform to the AWS Quality standards or as amended by these Specifications.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle finish carpentry in accordance with the AWS Quality Standards. Control the temperature and humidity in accordance with the AWS recommendations, before, during, and after finish carpentry delivery, and also during storage and installation.
- .2 Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in the installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with required specifies in "Field Conditions" Article.

1.05 FIELD CONDITIONS

- .1 Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets

are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Provide work of this Section in accordance with Architectural Woodwork Standards (AWS), except as specified otherwise herein. Any reference to grades and terminology in this Section to be as defined in "AWS" and by reference are made a part of this Section. Requirements of this Section govern and modify AWS.
- .2 Design and Performance Requirements:
 - .1 Architectural *Drawings* and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages
 - .2 Ensure millwork casework (e.g. countertops, wall cabinets, cabinet drawers and similar items) are capable of supporting structural loads without deflection in accordance with Casework Integrity Tests in Appendix A of AWS.
 - .3 Without limitations, in particular ensure millwork countertops are capable of supporting 907 kg (2000 lb) as per AWS Casework Integrity Tests AWS Appendix A.
 - .4 Minimum nominal thickness and material for cabinet components and shelf deflection, type of materials, thicknesses, span width and total load distribution: In accordance with Architectural Woodwork Standards Section 10.

2.02 MATERIALS

- .1 General: All materials under work of this Section, including but not limited to, adhesives and mastics, are to have low VOC content limits.
- .2 Concealed framing lumber and plywood:
 - .1 Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWS Custom Grade, S4S, average moisture content 7% +/- 2% at installation.
- .3 Softwood plywood: CSA O151-M; 19 mm unless indicated otherwise, (G2S).
- .4 Veneer core plywood (substrate): Baltic Birch plywood, Grade CP/CP or better, cross-banded layers of 1.5mm birch veneer, in sizes, thickness and shapes as indicated.
- .5 Plastic laminate: Provide plastic laminates conforming to ANSI/NEMA LD 3 as follows:
 - .1 Manufacturer: Wilsonart® Chemsurf® Chemical-Resistant Laminate.
 - .1 Colours: Selected by Architect from manufacturer's standard range.
 - .2 Substitutions: Not Permitted.
 - .2 Thickness: 0.86mm ± 0.13mm
 - .3 Backing sheet: thickness to match face sheet, high pressure laminate, manufactured by same manufacturer as face sheet.
- .6 Casework Hardware
 - .1 Cabinet door pulls: Richelieu SWF690170 Stainless Steel.
 - .2 Cabinet Locks: CompX National Cabinet Lock removable 4 pin tumbler, 14A bright nickel plated brass cylinder lock No. C8177 complete with nickel plated lock core, nickel plated C2017 rosette, and nickel plated strike to suit configuration. Keying and number of master keys shall be determined by the Owner. Provide locks for doors and drawers as indicated on drawings.

- .3 Recessed Shelf Pilasters, Standards and Clips: Provide "KV255" pilaster and "KV256" clip supports by Knappe & Vogt or "120-10 Series" pilasters and "1903-2G" clip supports by Richelieu Hardware Ltd.; www.richelieu.com. Finish: Bright Zinc.
- .4 Double Door Latch: Hafele 245.58.300 or CompX LOCDL300. Black finish.
- .5 Drawer and Hinged Door Bumpers: Provide 3 clear resilient, press-fit bumpers per door.
- .6 Concealed Hinges: heavy duty, sprung fully concealed for single doors, for back-to-back doors or gables, 94° opening against walls and 170° opening in all other locations, self-closing, nickel plated steel with zinc die cast screwed on clip, mounted at 18 inches (455 mm) o.c. maximum. Do not use sprung hinges with "touch latch" hardware. Julius Blum Canada Limited, Hettich Canada Limited Partnership, "Euromat Topsafe". Provide manufacturer's recommended number of hinges to suit door size and thickness.
- .7 Fastenings:
 - .1 Include necessary fastenings, anchors and accessories required for fabrication and erection of work of this Section.
 - .2 Fastenings include non-exhaustively: anchor bolts, machine bolts, toggle bolts, male/female bolts, lag screws, expansion shields, sleeves, brackets, washers and nuts.

2.03 PLASTIC LAMINATE WORK

- .1 Perform plastic laminate work in accordance with NAAWS and ANSI/NEMA LD 3.
- .2 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .3 Laminate plastic laminates to core materials in accordance with manufacturer's instructions.
- .4 Fabricate core surfaces and profiles with continuous support and bond over entire surface to receive plastic laminate.
- .5 Apply plastic laminate backing sheets to balance shrinkage stresses induced by plastic laminate face sheets.
- .6 Joints:
 - .1 Install joints in accordance with reviewed shop drawings.
 - .2 Jointing shall be placed at logical locations in intended millwork item and shall meet the overall aesthetic intent of the Consultant.
 - .3 Minimize joints in plastic laminate work.
 - .4 Do not install joints in plastic laminate work in less than 2400 mm o.c.
 - .5 Locate joints minimum 610 mm from cut-outs.
 - .6 Offset core and plastic laminate facing joints.
 - .7 Form shaped profiles and bends as indicated, using post formed grade laminate to laminate manufacturer's instructions.
 - .8 Edging to be done using straight self-edging laminate strip to match adjacent colour, finish, gloss, and pattern to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
 - .9 Apply laminated plastic liner sheet to interior of cabinetry and where indicated.
 - .10 Fabricate units by solid surfacing manufacturer's certified or approved fabricator/installer. Fabricate built-up profiles as indicated.

2.04 FABRICATION

- .1 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.
- .2 Coordinate locations of concealed supports and blocking with other parts of work. Provide cutouts for outlet boxes and other fixtures.

- .3 Fabricate work in a manner which will permit expansion and contraction of the materials without visible open joints. Conceal joints and connections in wherever possible.
- .4 Set nails and countersink screws, apply wood filler to indentations, sand smooth and leave ready to receive finish.
- .5 Finished millwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.

PART 3 EXECUTION

3.01 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.02 PREPARATION

- .1 Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.03 INSTALLATION

- .1 Install finish carpentry work in accordance with AWS Quality Standards and tolerances for Architectural Woodwork and reviewed shop drawings.
- .2 Set and secure finish carpentry in place, rigid, plumb, square, and level.
- .3 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.
- .4 Coordinate cutouts for inserts, appliances, outlet boxes, and other fixtures, in finish carpentry. Round internal corners of cut-outs and seal exposed cores.
- .5 Form joints to conceal shrinkage.
- .6 Install draw bolts and splines in laminated plastic counter top joints at maximum spacing 450 mm o.c., and 75 mm from edge. Make joints flush, hairline butt joints.
- .7 Install finishing hardware accurately and securely in accordance with manufacturer's directions, adjust and clean.
- .8 Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- .9 Anchor cabinet to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- .10 Install cabinets without distortion so door and drawers fit openings and are accurately aligned. Adjust hardware as shown in the drawings and to provide unencumbered operation. Complete installation of hardware and necessary item as indicated.
- .11 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.
- .12 Fastening:
 - .1 Fasten wall cabinets through back, near top and bottom, and at ends not more than 400 o.c. (16").
 - .2 Coordinate wall securement, anchorage, and blocking for finish carpentry items.
 - .3 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
 - .4 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
 - .5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
- .13 Remove and replace damaged, marked, or stained finish carpentry.

3.04 ADJUSTING AND CLEANING

- .1 Clean, lubricate, and adjust hardware.
- .2 Clean cabinets on exposed and semi exposed surfaces. Clean decorative plastic laminate surfaces in accordance with manufacturer's written care and maintenance instructions.
- .3 Protect completed Work from damage for duration of construction period.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

- .1 Work Included: *Provide* firestopping and smoke seals in accordance with Code requirements, at openings and around penetrations, at un-penetrated openings, at projecting and recessed items and at openings and joints within fire separations and assemblies having fire resistance rating including all necessary accessories to complete firestopping work, excluding those inside sealed mechanical and electrical assemblies.
- .2 *Provide* tested firestop material or material systems used to retain integrity of fire-rated construction by maintaining effective barrier against spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies, including:
 - .1 Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated walls and partitions, horizontal floor/ceiling assemblies and vertical service shaft walls and partitions.
 - .2 Gaps between top of walls and ceilings or roof assemblies.
 - .3 Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - .4 Openings around structural members that penetrate floors or walls.
- .3 Install firestopping components by an experienced applicator approved by the manufacturer of system used.
- .4 Firestop system to meet requirements of CAN4-S115-M, ULC S-115-M tested assemblies providing a fire rating equivalent to the required supporting construction assembly.
- .5 Firestop System Rating:
 - .1 For penetrations through fire wall or horizontal fire separation provide firestop system with a 'FT' rating as determined by ULC or cUL which is equal to fire resistance rating of construction being penetrated.
 - .2 For combustible pipes, tubing, ducts, chimneys, optical fibre cables, electrical wires and cables, totally enclosed non-combustible raceways, electrical outlet boxes and similar building services that penetrate through a fire separation provide a firestop system with 'F' Rating as determined by ULC or cUL as indicated below:

<u>Separation Fire Resistance Rating</u>	<u>Firestopping Required ULC or cUL 'F' Rating</u>
45 minutes	45 minutes
1 hour	45 minutes
1.5 hours	1 hour
2 hours	1.5 hour
- .6 For combustible pipe penetrations through a fire separation provide a firestop system with a 'F' Rating as determined by ULC or cUL (when tested with a pressure differential of 50 Pa between exposed and unexposed sides) which is equal to the fire resistance rating of the construction being penetrated.
- .7 Related Requirements: Following description of work is included for reference only and shall not be presumed to be complete:
 - .1 Sprayed fireproofing of beams, columns and metal deck: Section 07 81 00, Sprayed Fireproofing.
 - .2 Firestopping and smoke seals inside sealed mechanical and electrical assemblies: Divisions 21, 22, 23 and 26 respectively.

1.02 REFERENCES

- .1 Reference Standards
 - .1 ANSI/UL 1479-03(10): Fire Tests Of Through-Penetration Firestops
 - .2 ASTM E814-10: Standard Test Method for Fire Tests of Penetration Firestop Systems
 - .3 ANSI/UL 2079-04(08): Tests for Fire Resistance of Building Joint Systems
 - .4 CAN/ULC S115-05: Standard Method of Fire Test of Firestop Systems
 - .5 ULC Guide No. 40U19: Firestop Systems

.6 ULC Guide No. 40U19.13: Firestop Systems Components

.7 UL: Listing of Equipment and Materials

1.03 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's literature, data sheets for each type of material provided under this Section for *Project*. Data sheets shall *Provide* all required information. Submit 3 copies of detailed instructions for maintaining, preserving and keeping materials in clean and safe conditions and give adequate warning of maintenance practices or materials detrimental to specified materials. Submit manufacturer's installation instructions.

.2 Submit manufacturer's data sheet for each *Product* and materials required for work of this Section. Data sheets shall *Provide* all required information.

.3 Material Safety Data Sheets: Submit MSDS for inclusion in Operation and Maintenance Manual without limitations for adhesives, sealants, patching and leveling compound, solid polymer and as designated later by *Consultant*.

.2 *Shop Drawings*: Submit *Shop Drawings* in accordance with Section 01 30 00. Submit complete and detailed *Shop Drawings* indicating ULC and/or cUL assembly number certification and material safety data sheets.

.3 Samples: Submit only as requested and in accordance with Section 01 30 00, various types of firestopping and smoke seal material.

1.04 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing *Products* of this Section with minimum three (3) years documented experience quality management system registered in accordance with requirements of ISO 9001.

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

1.05 ENVIRONMENTAL REQUIREMENTS

.1 Comply with manufacturer's installation recommendations for temperature, humidity, and ventilation conditions.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to Site in manufacturer's sealed and labelled containers intact.

.2 Handle and store materials in accordance with manufacturer's instructions.

1.07 PROJECT CONDITIONS

.1 Comply with manufacturer's recommended requirements for temperature, relative humidity and substrate conditions during application and curing of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

.1 *Products* of following manufacturers are acceptable subject to conformance to requirements of *Drawings*, Schedules and *Specifications*:

.1 3M Canada Inc.

.2 Hilti Canada Corp.

.3 NUCO Inc.

.4 STI Firestop.

.5 Tremco Commercial Sealants & Waterproofing.

2.02 DESCRIPTION

.1 Regulatory Requirements:

.1 Conform to Ontario Building Code, ULC, cUL UL, WH, FM listings and CAN/ULC4-S115-5, ANSI/UL 1479, ANSI/UL 2079, ASTM E814 fire test standard to achieve the required fire protection rating.

- .2 Firestopping Materials: *Provide* firestopping system(s) to *Provide* and maintain a fire resistance rating, as indicated on *Drawings* and in accordance with UL, ITS, ULC, cUL or FM design details.
- .3 Design Requirements:
 - .1 Design firestopping to meet or exceed requirements of local Code authorities; submit *Drawings* signed and sealed by professional engineer registered in the Place of *Work* complete with material data sheets and instructions for firestopping.

2.03 MATERIALS

- .1 Certified and listed by ULC or WH in accordance with ULC S115-05 and bearing ULC or WH label, *Products* shall be heat resistant, flexible, durable and compatible with adjacent materials and finishes. System shall be self supporting at penetration capable to adhere and yet maintain its integrity while providing effective barrier against passage of flame, smoke and gases. *Product* shall *Provide* flame and temperature rating in accordance with requirements of OBC for openings in respective fire resistance rated floor, wall or other assembly.
- .2 Firestop systems: Certified by ULC, WH and listed in ULC Guide No. 40 U19.
- .3 Firestop system components: Certified by ULC, WH and listed in ULC Guide No. 40 U19.13 under the Label Service of ULC.
- .4 Cementitious matrices shall *Provide* minimum 2758 kPa (400 psi) compressive strength when cured, to retard cable tray warping within the firestop seal.
- .5 Firestopping and smoke seals at openings where reinstallation occurs: An elastomeric or reusable cementitious matrix or putty seal; do not use a permanent cementitious seal at such locations.
- .6 Firestopping and smoke seals at openings around penetrations for electrical bus ducts, pipes, ductwork and other electrical and mechanical items requiring sound and vibration control or allowance for expansion, contraction and other movement: An elastomeric seal; do not use a cementitious or rigid seal at such locations.
- .7 Firestopping and smoke seals at joints and spaces designed and required to allow movement such as building movement joints, deflection spaces, control joints, expansion joints, and similar locations shall be flexible, elastomeric seal suitable to withstand the required movement and capable of returning to original configuration without damage to seal and without adhesive or cohesive failure; do not use a cementitious or rigid seal at such locations.
- .8 Material(s) shall be Mineral Wool or Silicone or Silicone SL Sealants or Mortar or Collars or Intumescent Caulk or Pillows or Seal or Seal NS or Inserts or Putty or Wrap Strip or Collar Strip or Putty Pads.
- .9 Firestop system ratings: Comply with applicable Building Code requirements for locations and hourly ratings of F, FT, FH and FTH designations.
- .10 Damming and backup materials, supports and anchoring devices shall be in accordance with manufacturer's recommendations, tested firestop system/design and as acceptable to authorities having jurisdiction.
- .11 Primers: As required by firestopping manufacturer and compatible with selected system and contiguous materials.
- .12 Water: Potable
- .13 Pipe and duct insulation and wrappings compatible with firestopping systems.
- .14 Intumescent pads: Permanently pliable type.
- .15 Intumescent composite sheet: Composite sheet, strip or precut shapes.
- .16 Sealants and putty for vertical and overhead joints: Non-sagging.
- .17 Sealants and fluid seals at floors: Self-levelling.
- .18 Materials and *Products* shall not cause stress, chemical or physical reaction, or other damage to penetrating items or adjacent materials.

PART 3 – EXECUTION

3.01 EXAMINATION

- .1 Examine substrates, openings, voids, adjoining construction and conditions under which firestop is to be installed. Confirm

compatibility of surfaces.

- .2 Verify penetrating items are securely fixed and properly located with proper space allowance between penetrations and surfaces of openings.

3.02 PREPARATION

- .1 Surfaces to receive firestopping shall be free of dirt, dust, grease, oil, rust, loose materials, release agents, frost, moisture or any other matter which would impair bond of firestopping material to substrate of penetrating item(s).
- .2 Prime substrates in accordance with manufacturer's written instructions.
- .3 Do not apply firestopping and smoke seals to surfaces previously painted or treated with sealers, curing compounds, water repellent or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure that anchoring devices, back-up materials, clips, sleeves, supports and other related materials used in actual fire tests are provided.
- .5 Ensure fire stop system do not affect structural integrity of load bearing partitions and assemblies or live load and traffic. Verify with professional structural engineer prior to penetrating any load bearing assembly.
- .6 Mask where necessary to prevent firestopping materials from contacting adjoining surfaces that will remain exposed upon completion of work. Remove tape as soon as it is possible to do so without damaging firestop material or substrate.

3.03 INSTALLATION

- .1 Comply with UL, ULC, cUL, ITS or FM Listings and manufacturer's instructions for type of material and condition of opening in each case. Consult with manufacturer to determine proper procedure for conditions not fully covered by printed instructions. Record in writing any oral instructions received, with copy to manufacturer.
- .2 For those fire stop applications for which no ULC or tested systems are available through manufacturers, a manufacturer's engineering judgment derived from similar ULC system designs or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Submit engineer judgment *Drawings* where applicable to authorities having jurisdiction.
- .3 Remove excess firestopping material promptly as work progresses and upon completion.
- .4 *Provide* leak-proof dams as required to seal openings and contain firestop until cured. *Install* damming in accordance with test design and manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

- .1 Notify *Consultant* when completed installations are ready for inspection prior to concealing or enclosing an area containing firestopping materials.
- .2 Independent inspection and testing company may be appointed and paid for by *Owner* to carry out additional inspection and testing as directed by *Consultant*. Cooperate, coordinate, and arrange for inspections by independent inspection and testing company at required time.
- .3 Following field inspections, *Provide* all repair as required to ensure compliance with *Contract Documents*.

3.05 CLEANING AND PROTECTION

- .1 Upon completion of this work, remove all materials, equipment and debris from site. Leave *Work* area and adjacent surfaces in a condition acceptable to *Consultant*.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- .1 Preparing substrate surfaces.
- .2 Sealant and joint backing.

1.02 SUBMITTALS

- .1 *Product Data*: Submit manufacturer's literature, data sheets for each type of material provided under this Section for Project. Submit detailed instructions for maintaining, preserving and keeping materials in clean and safe conditions and give adequate warning of maintenance practices or materials detrimental to specified materials. Submit manufacturer's installation instructions.
- .2 *Samples*: Submit samples in accordance with Section 01 30 00. *Provide* cured, colour samples of manufacturer's standard range of colours in each type of sealant and caulking compound for colour selection by *Consultant*. Submit samples of primer, bond breaker tape and joint backing material, if requested.

1.03 QUALITY ASSURANCE

- .1 *Qualifications*: *Provide* work of this Section executed by competent installers who have a membership in good standing in the Sealant and Waterproofing Association and with minimum of 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver caulking and sealant materials to site in original, unopened containers with manufacturers' labels and seals intact. Labels to identify manufacturer's name, brand name of *Product*, grade and type, application directions and shelf life or expiry date of *Product*.
- .2 Handle and store materials in accordance with manufacturer's printed directions. Store flammable materials in safe, approved containers to eliminate fire hazards.
- .3 Do not use caulking and sealant materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.05 PROJECT CONDITIONS

- .1 *Environmental Requirements*: Do not apply any sealant under adverse weather conditions, when joints to be sealed are damp, wet or frozen or when at ambient temperatures below 5 deg C (40 deg F). Maintain minimum temperature of application during application and for 8 hours after application. Consult manufacturer for specific instructions before proceeding and obtain *Consultant's* approval.
- .2 Do not proceed with installation joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated and until contaminants capable of interfering with adhesion are removed from joint substrates.

1.06 WARRANTY

- .1 Warrant work of this Section for period of 5 years against defects and/or deficiencies in accordance with General Conditions of the *Contract*. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of *Consultant* and at no expense to *Owner*. Defects include but are not limited to; cracking, crumbling, melting, shrinkage, sag, failure of adhesion, cohesion or reversion, air and moisture leakage, marbling or streaking due to improper mixing, discolouration due to dirt pick-up during curing and staining of adjacent materials."

PART 2 – PRODUCTS

2.01 SEALANTS

- .1 Laboratory Silicone Sealant (Type A): ASTM C920, Type S, Grade NS, Class 50, Use NT, DWRI Validated; single component, neutral curing, non-sagging, non-staining, fungus resistant non-bleeding; colour as selected.
 - .1 Elongation Capability 35 - 50% .

- .2 Service Temperature Range -54 to 82 degrees C.
- .3 Shore A Hardness Range 40.
- .4 Product: Spectrem 2, manufactured by Tremco.
- .5 Product: equivalent product, manufactured by Dow Corning.

2.02 ACCESSORIES

- .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- .3 Joint Backing: ASTM C1330, round, closed cell; polyethylene foam rod, oversized 30% to 50% larger than joint width.
- .4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- .5 Masking tape: Non-staining, non-absorbent type compatible with sealant and adjacent surfaces.
Setting Blocks and Spacers: Compatible with silicone sealant and recommended by sealant manufacturer.

PART 3 – EXECUTION

3.01 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.

3.02 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 Non-porous surfaces shall be cleaned using the two-cloth wipe method as referenced in ASTM C1193-16 and outlined by joint sealant manufacturer's written requirements.
- .6 Rusting or scaling surfaces shall be prepared using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Efflorescence, mould, mildew and algae must be removed and neutralized 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.

3.03 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.

3.04 INSTALLATION

- .1 Perform installation in accordance with ASTM C1193 for solvent release and latex base sealants, ASTM C919 for acoustical sealants .

- .2 Perform installation in accordance with ASTM C920 for neutral cure and silicone base sealants.
- .3 Install sealant to sealant manufacturer's written instructions.
- .4 Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
- .5 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .6 Install bond breaker where joint backing is not used.
- .7 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .8 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .9 Tool joints concave channel shaped as detailed.
- .10 For laboratories:
 - .1 Backsplashes that are continuous or sealed at the junction between the wall and bench shall provide a continuous barrier designed to prevent contaminated liquids from reaching surfaces that are hard to access and decontaminate. Use a continuous bead of silicone sealant as caulking can be used to create a continuous surface.
 - .2 The continuity of adjacent surfaces (e.g., walls and floors, benchtops and other work surfaces) and overlapping material (e.g., flooring, baseboards, coving, backsplashes) shall provide a continuous barrier designed to prevent contaminated liquids from reaching surfaces that are hard to access and decontaminate. Use a continuous bead of silicone sealant to create a continuous surface.
 - .3 Continuity of seal to be maintained between the floor and wall.
 - .4 Continuity of seal to be maintained between the wall and ceiling.
 - .5 Sealing these listed gaps with sealants allows for proper spill cleanup and surface decontamination, and maintains the integrity of the containment barrier.
 - .6 Ensure continuous seals and surfaces maintain the containment barrier, and allow areas or surfaces to be effectively decontaminated. A visual inspection will allow the identification of areas that have lost their integrity and that need repair. A visual inspection includes verifying floors, walls, and ceilings, as well as floor/wall and wall/ceiling joints for cracks, chips, and wear. Identifying surfaces on the containment barrier that have lost their integrity is essential to protect personnel from exposure and to prevent a breach of containment. This visual inspection will be conducted and is intended to verify the performance of seals and surfaces in accordance with requirements of Canadian Biosafety Standard, Containment Level 2.

3.05 SCHEDULE INTERIOR LABORATORY SEALANTS

- .1 Silicone Sealant Type A:
 - .2 Cabinetry / countertops / shelving –
 - .1 Seal these components where they contact dissimilar materials and where they contact one another (including free standing shelving units)
 - .2 Seal all joints along counter tops where they contact with dissimilar material.
 - .3 Seal joints at all sides of wall mounted shelves.
 - .4 Seal all gaps and openings where cabinet legs attach to and penetrate cabinet components.
 - .5 Countertops, backsplashes and shelving, when installed tight to the wall, to be sealed at the wall-bench junction and continuous with work surfaces.
 - .3 Walls / floors
 - .1 Type A Sealant: All penetrations of the containment barrier, including all conduits and wiring, to be sealed with a non-shrinking sealant that is compatible with the disinfectant(s) in use.
 - .2 Type A Sealant: Seal top of trim strip and sheet flooring at wall

- .3 Type A Sealant: Seal top and bottom of cove base
- .4 Equipment
 - .1 Type A Sealant: Seal large gaps between fixed equipment and adjacent casework and walls (e.g. fume hood).
 - .2 Type A Sealant: Seal all gaps and openings around secured / fixed equipment
 - .3 Ensure that fixed equipment on the containment barrier and adjacent surfaces maintains a continuous to protect the integrity of the containment barrier and protects against the inadvertent release of infectious material or toxins.
- .5 Plumbing
 - .1 Seal around all plumbing escutcheon and cover plates at the wall.
- .6 Fixtures
 - .1 Seal stainless steel equipment at all joints and gaps
 - .2 Seal perimeter of sink faucets.
- .7 HVAC
 - .1 Supply air ductwork located between the containment barrier and backdraft protection to be sealed airtight in accordance with ANSI/SMACNA 016 Seal Class A.
 - .2 Exhaust air ductwork located between the containment barrier and HEPA filter(s) or isolation damper(s) to be sealed airtight in accordance with ANSI/SMACNA 016 Seal Class A.
- .8 Electrical
 - .1 Seal perimeter of all penetrations in containment barrier at conduits and wiring, electrical outlets and surface mounted electrical boxes on countertops.
 - .2 Seal underside of horizontal (moveable) electrical raceways above counter tops.
- .9 Seal the joints and penetrations listed herein to ensure the integrity of penetrations of the containment barrier, seals, and surfaces to the satisfaction of University of Toronto Department of Environmental Health and Safety.
- 3.06 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.
- 3.07 PROTECTION**
 - .1 Protect installed sealants during and after final curing from damage resulting during construction.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

.1 Work Included: *Provide* steel door and frame including but not limited to following:

- .1 Interior hollow metal door, swing flush type, hollow metal door frame.

1.02 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.

1.03 SUBMITTALS

.1 Product Data: Submit manufacturer's literature and data sheets for each type of material provided under this Section.

.2 *Shop Drawings*: Submit *Shop Drawings* in accordance with Section 01 30 00.

- .1 Ensure *Shop Drawings* or manufacturer's catalogue sheets contain detailed description, and bear item numbers, marked to show quantity, colour, model numbers, fabrication details and installation instructions. Ensure *Shop Drawings* show following:
 - .1 detailed elevations of all doors and frames,
 - .2 jamb and head details for all frame types,
 - .3 meeting and style details on pairs of doors,
 - .4 materials used,
 - .5 core thicknesses,
 - .6 mortises, reinforcements,
 - .7 location of exposed fasteners,
 - .8 arrangement of hardware,
 - .9 methods of anchorage.
- .2 Schedules: Submit a schedule indicating each door and frame related to Door Schedule. Identify each unit with door marks and numbers relating to numbering on Drawings and in Door Schedules.
- .3 Field Measurements: Take field measurements prior to preparation of *Shop Drawings* and fabrication to ensure proper fitting of work. Do not fabricate work until *Shop Drawings* and hardware schedules have been reviewed.

1.04 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Execute work of this Section by a manufacturer who is a member of the Canadian Steel Door Manufacturers Association (CSDMA).

.2 Supplier Qualifications: Ensure Product Supplier has Architectural Hardware Consultant (AHC) or person of equivalent experience, available at reasonable times to consult with Consultant, Contractor and Owner.

.3 Installer Qualifications:

- .1 Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Ensure retained installers are familiar with Product manufacturers specified herein and with ANSI/NFPA 80 requirements for installation of labeled fire rated steel doors, frames and hardware.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Brace frame units with two temporary steel jamb spreaders welded to the base of jambs or mullions to prevent distortion in shipment, and protect finished surfaces by sturdy protective wrappings.

.2 Upon receipt at site remove protective wrappings or coverings. Store doors and frames in a secure dry location. Protect from

damage from any cause. Store doors and frames vertically, on planks, with blocking between to allow air to circulate.

- .3 Repair shipping and handling damage to galvanized finishes immediately it occurs to prevent rusting. Use zinc rich primer for painted surfaces.
- .4 Store products out of water and under weatherproof protective covers as required by project conditions.

PART 2 – PRODUCTS

2.01 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Ensure Product quality meets standards set by Canadian Steel Door Manufacturers Association (CSDMA).

2.02 MATERIALS

- .1 Base Material for steel door faces sheets and frame profiles.
 - .1 Galvanneal Sheet Steel: Commercial grade steel (CS) to ASTM A568/A568M, with zinc hot-dip galvanized coating (commercially known as "Galvanneal") in accordance with ASTM A653/A653M. Coating Designation: ZF120 (A40).
- .2 Door Cores: Refer to individual door types for applicability of cores specified herein.
 - .1 Honeycomb: Structural small cell (25 mm (1") maximum), kraft paper "honeycomb"; weight: 36 kg (80 lb) per ream (minimum), density: 16.5 kg/m³ (1.03 lbs/cu ft) minimum. Provide items sanded to required thickness.
- .3 Adhesives: Provide UL/WH approved, heat resistant, adhesives for applications indicated:
 - .1 Laminated Cores and Steel Components: Heat resistant, single component. Polyurethane reactive (water) hot melt, thermoset.
 - .2 Lock-Seam Doors: Fire resistant, resin reinforced polychloroprene (RRPC), fire resistant, high viscosity sealant/adhesive.
- .4 Primer: Rust inhibitive touch-up only.
- .5 Door Silencers (Bumpers): Single stud rubber/neoprene type.

2.03 FABRICATION - GENERAL

- .1 Fabricate steel doors and frames 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 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 to CSA W59-13.
- .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 ratings.

2.04 FABRICATION – STEEL DOORS AND PANELS

- .1 Fabrication - Steel Doors and Panels
 - .1 Fabricate steel doors and panels to a thickness of 44 mm (1-3/4"), unless indicated otherwise.
- .2 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 Tack welded at top and bottom of door, 150 mm (6") on centre, and above and below each edge cutout, filled and ground smooth with no visible seams.
- .3 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.
- .4 Formed edges shall be true and straight with minimum radius for the thickness of steel used.
- .5 Lock and hinge edges shall be bevelled 3 mm in 50 mm (1/8" in 2") unless hardware or door swing dictates otherwise.
- .6 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.
- .7 Prior to shipment, mark each door with an identification number as shown on the approved submittal drawings.
- .8 Blank, reinforce, drill and tap doors for mortised, templated hardware. Locate hardware to manufacturer's standard unless indicated otherwise.
- .9 Holes 12.7 mm (1/2") and larger shall be factory prepared.

2.05 FABRICATION – STEEL FRAMES

- .1 General: Applicable to frames and screen assemblies.
- .2 Interior and non-thermally broken frames; welded:
 - .1 Fabricated from 1.70 mm (0.067") (14 gauge) steel for frames.
 - .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 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.
- .6 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 Sound, light, or smoke sealed doors: None required.
- .7 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.

- .8 Conceal fastenings unless otherwise indicated.
- .9 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.
- .10 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .11 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction.
- .12 Reinforce head of frames wider than 1220 mm (48").
- .13 Brace frame units to prevent distortion in shipment and protect finish.

2.06 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.

2.07 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 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.

2.08 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").

2.09 HARDWARE LOCATIONS

- .1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in this section.
- .2 Top of upper hinge preparation for 114 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 mm (4.5") hinges shall be located 310 mm (12.625") from finished floor as defined in 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

3.01 EXAMINATION

- .1 Before fabrication of doors and frames, take site measurements of construction to which work of this Section must conform, to ensure that alteration of product is not required. Alterations to doors and frames in the field will not be allowed.

3.02 INSTALLATION

- .1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-17.
- .2 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 ($\pm 1/16$ ").
 - .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 ($\pm 1/16$ ").
 - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ ").
- .3 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.
- .4 Provide vertical support at center of head for openings exceeding 1250 mm (48") in width.
- .5 Secure anchorages and connections to adjacent construction.
- .6 Execute installation and assembly using skilled forces under supervision of a competent joinery foreperson.
- .7 Install doors in accordance with NAAMM-HMMA 840-17, maintaining clearances outlined in this section.

- .8 Adjust operable parts for correct clearances and function.
- .9 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
- .10 Remove grout or other bonding material from products immediately following installation.
- .11 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.
- .12 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.
- .13 Fill and grind smooth "punch and dimpled" frame installations.
- .14 Prior to site touch-up, exposed surfaces of galvanized 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.
- .15 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.
- .16 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.
- .17 Finish paint in accordance with Section 09 91 00.
- .18 Install door silencers.
- .19 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.
- .20 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .21 Adjust operable parts for correct clearances and function.

3.03 ADJUST AND CLEANING

- .1 Check and readjust operating hardware items immediately before final inspection. Remove and replace defective work, including doors and frames that are warped, bowed, or otherwise unacceptable.
- .2 Clean grout and other bonding material off detention doors and frames immediately after installation. Carefully wipe clean doors of dust created due to work of this Project.
- .3 Touch-ups: Immediately after erection clean and repair surfaces in accordance with manufacturer's written instructions
- .4 Verify and adjust each door to ensure proper operation.
- .5 Carefully wipe clean doors of dust created due to work of this *Project*.
- .6 Replace defective doors as directed by *Consultant*.

END OF SECTION

PART 1 GENERAL

1.01 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 Division 1 requirements and documents referred to therein.
 - .2 UTM Standard Door Hardware.

1.02 REFERENCES

- .1 Reference Standards
 - .1 CAN/CGSB 69.17/ANSI/BHMA A156.2-03: Bored and Preassembled Locks and Latches
 - .2 CAN/CGSB 69.18/ANSI/BHMA A156.1-06: Butts and Hinges
 - .3 CAN/CGSB 69.20/ANSI/BHMA A156.4-00: Door Controls (Closers)
 - .4 CAN/CGSB 69.21/ANSI/BHMA A156.5-01: Auxiliary Locks and Associated *Products*
 - .5 CAN/CGSB 69.22/ANSI/BHMA A156.6-05: Architectural Door Trim
 - .6 CAN/CGSB 69.23/ANSI/BHMA A156.7-03: Template Hinge Dimensions
 - .7 CAN/CGSB 69.24/ANSI/BHMA A156.8-05: Door Controls - Overhead Holders
 - .8 CAN/CGSB 69.29/ANSI/BHMA A156.13-05: Mortise Locks and Latches
 - .9 CAN/CGSB 69.31/ANSI/BHMA A156.15-06: Closer/Holder Release Device
 - .10 CAN/CGSB 69.32/ANSI/BHMA A156.16-02: Auxiliary Hardware
 - .11 CAN/CGSB 69.34/ANSI/BHMA A156.18-06: Materials and Finishes
 - .12 CSA: Canadian Standards Association

1.03 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's literature, data sheets for each type of material provided under this Section for *Project*. Data sheets shall *provide* all required information. Submit detailed instructions for maintaining, preserving and keeping materials in clean and safe conditions and give adequate warning of maintenance practices or materials detrimental to specified materials. Submit manufacturer's installation instructions.
- .2 Shop Drawings:
 - .1 Submit *Shop Drawings* for hardware installation in accordance with Section 01 30 00.
 - .2 Submit *Shop Drawings* in schedule form, indicating manufacturers' names, *Product* descriptions, makes, models, materials, finishes, functions, location of each item, complete keying schedule and other pertinent information. Repeat hardware item numbers used in Finish Hardware Schedule. Include list of abbreviations and finish symbols and their meaning. Include manufacturer's cut sheets for each hardware item.
- .3 Operations and Maintenance Data
 - .1 Prior to Substantial Performance, provide two (2) copies of the following information for inclusion in Operation and Maintenance Manuals in accordance with Section 01 77 00.:
 - .1 Maintenance instructions for each hardware item
 - .2 Catalogue cut sheets and product specifications of each product.
 - .3 Parts list for each product
 - .4 Copy of final 'as-built' finish hardware schedule

1.04 DELIVERY, STORAGE AND HANDLING

- .1 *Supply* scheduled hardware to the *Place of The Work*.
- .2 Pack hardware in suitable wrappings and containers to protect from damage during shipping and storage. Enclose accessories, fastening devices and other loose items with each item. Pack screws, bolts and fastenings necessary for proper installation in same package. Mark packages for easy identification legibly indicating manufacturer's numbers, types, sizes.
- .3 *Provide* templates, template information, installation instructions and details necessary for preparation and installation of hardware.

1.05 WARRANTY

- .1 Warrant work of this Section for period of 2 years for general, 10 years for closers and lifetime for butt hinges against defects and/or deficiencies in accordance with General Conditions of the *Contract*. Promptly correct any defects or deficiencies which become apparent within warranty period including making good any work damaged by this work, to satisfaction of *Consultant* and at no expense to *Owner*.

1.06 MAINTENANCE

- .1 Maintenance Instructions:
 - .1 Instruct *Owner's* designated representative in proper care and preventative maintenance of hardware to assure longevity of operation.
 - .2 *Provide* descriptive information, operating, adjustment and maintenance instructions, and "As-Built" record of location of each hardware group and other pertinent information.
 - .3 *Provide* maintenance data, parts list and manufacturer's instructions for each type of door closer, lockset, fire exit hardware and door holder. *Provide* manufacturer's instructions for proper care of hardware, including lubrication, for incorporation into operation and maintenance instruction manual.
- .2 Tools for Maintenance: Prior to date of Substantial Performance, *Supply* a complete set of specialized tools as needed for *Owner's* continued adjustment, maintenance and removal and replacement of builders hardware.

PART 2 - PRODUCTS

2.01 FINISH HARDWARE

- .1 *Provide* door closers, locksets and latch sets meeting ANSI/BHMA Qualified *Products* List. *Provide* finish hardware in accordance with Finish Hardware Schedule. No substitutions are allowed without written approval of *Consultant*.

2.02 MATERIALS

- .1 Fabricate all hardware to template. Provide template and template hardware together with the instructions necessary for door and frame preparation.
- .2 Supply all hardware with necessary screws, bolts or other fastening devices to anchor hardware in position neatly and properly in accordance with best practices.
- .3 Use one manufacturer's products only for all similar items.

2.03 FASTENINGS

- .1 *Supply* screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .2 Exposed fastening devices to match finish of hardware.
- .3 Where pull is scheduled on 1 side of door and push plate on other side, *Supply* fastening devices and *Install* so pull can be secured through door from reverse side. *Install* push plate to cover fasteners. Prepare holes or cut-outs for cylinders or

deadlocks in push plates where applicable.

2.04 KEYING

- .1 *Provide* operational brass construction cores for all locks and cylinders. Cores will be returned to manufacturer when permanent cores are provided.
- .2 *Provide* 2 construction keys for use by *Contractor*, as well as 2 construction control keys for use by *Owner*.

2.05 HARDWARE PRODUCTS

- .1 Provide hardware as indicated in Hardware Schedule noted on the Architectural Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- .1 Before supplying any hardware and installation instructions, carefully check *Drawings* for work requiring hardware, verify door swings, door and frame materials and operating conditions and assure 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. Ensure doors, frames and panels requiring additional support are reinforced.
- .3 Point out special requirements to installer and ensure final adjustment of hardware, in particular closer arms, valves and locksets has all been done properly.
- .4 Be responsible to check and confirm dimensions for all hardware for this *Project*, including door protection, overhead stop sizes and other related hardware items that may require coordination for sizing.

3.02 INSTALLATION

- .1 *Install* hardware to doors and frames in accordance with manufacturer's packaged installation, template, and adjusting instructions.
- .2 Adjust hardware to *Provide* smooth operation of doors and ensure clearances are maintained. *Provide* lubricants to allow smooth function of hardware consistent with manufacturer's recommendations.
- .3 Mount hardware at heights in accordance with the "Recommended Locations for Builder's Hardware" by the Door and Hardware Institute (DHI) except as otherwise indicated on the Documents or required by the authorities having jurisdiction.
- .4 Ensure that all locksets / latchsets / deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position. Handing is part of installation procedure.
- .5 Tighten fastening components snugly. Do not burr or otherwise mar the edges of surfaces of hardware components. Repair defects resulting from work of this Section in accordance with *Consultant's* review.
- .6 Unless otherwise indicated, mounting heights for door hardware is as follows:
 - .1 Locksets - 1023 mm (40-5/16") from floor to centre line of knob.
 - .2 Deadlocks - 1524 mm (60") from floor to centre line of cylinder.
- .7 Remove construction locks when directed by *Consultant*.

3.03 ADJUSTING AND CLEANING

- .1 Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.
- .2 All hardware to be left clean and free of disfigurements.
- .3 Check all locked doors against approved keying schedule.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

- .1 Section includes:
 - .1 Regular gypsum board.
 - .2 Metal support systems for interior gypsum board partitions and interior assemblies.

1.02 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's literature, data sheets for each type of material provided under this Section for *Project*. Data sheets shall *Provide* all required information. Submit detailed instructions for maintaining, preserving and keeping materials in clean and safe conditions and give adequate warning of maintenance practices or materials detrimental to specified materials. Submit manufacturer's installation instructions.
 - .2 Material Safety Data Sheets: Submit MSDS for inclusion in Operation and Maintenance Manual without limitations for adhesives, sealants, patching and leveling compound, solid polymer and as designated later by *Consultant*.
- .2 *Shop Drawings*: Submit *Shop Drawings* in accordance with Section 01 30 00 showing design, construction, sound attenuating construction, adjacent construction, locations of access panels, elevations, finishes and relevant details of furring, enclosures and partitions which require fire rating.

1.03 QUALITY ASSURANCE

- .1 Applicator Qualifications: *Provide* work of this Section executed by competent installers with minimum of 5 years experience in application of *Products*, systems and assemblies specified.
- .2 Single Source Responsibility: Ensure materials specified herein are provided by a single seismic restraint manufacturer to ensure sole source responsibility for performance of seismic restraints used.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site with manufacturer's original labels intact. Do not remove wrappings until ready for use.
- .2 No outside storage permitted. Store in clean, dry area, off ground. *Provide* adequate ventilation to avoid excess moisture, surface relative humidity and mould or fungal growth. Remove immediately any board showing signs of mould, mildew or fungal growth.
- .3 Stack gypsum board flat on level and dry surface without overhanging boards. Prevent sagging and damage to edges, ends and surfaces. Protect bagged *Products* from moisture or wetting.

1.05 PROJECT CONDITIONS

- .1 Cooperate and coordinate with Sections applying wet trades and trades installing mechanical and electrical services. Do not *Install* work of this Section in any area unless satisfied that work in place has dried out and that no further installation of materials requiring wetness, moisture or dampness is contemplated. Relative humidity in area of work of this Section shall not exceed 55% for duration of *Project*. Coordinate stud layout at partitions accommodating wall mounted fixtures by other trades.
- .2 Ensure temperature of surrounding areas is min 13 deg C (55 deg F) and max 21 deg C (70 deg F) for 7 *Days* before and during application of gypsum board; maintain for 4 *Days* thereafter. Ensure heat is provided at appropriate time before work has started to bring surrounding and adjacent materials up to required temperature and maintained as specified. Avoid concentrated or irregular heating during drying by means of deflectors or protective screens.
- .3 Ensure ventilation is provided for proper drying of joint filler and adhesive and to prevent excessive humidity. Do not force dry adhesives and joint treatment.
- .4 *Provide* protection of materials and work of this Section from damage by weather and other causes. Perform work in areas closed and protected from damage due to weather. Protect work of other trades from damage resulting from work of this Section. *Make Good* such damage immediately.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

.1 Products of following manufacturers are acceptable subject to conformance to requirements of *Drawings*, Schedules and *Specifications*:

- .1 Bailey Metal Products Ltd.; www.bmp-group.com
- .2 CertainTeed Gypsum Canada Inc.; www.certainteed.com
- .3 Chicago Metallic; www.chicagometallic.com
- .4 CGC Inc; www.cgcinc.com
- .5 Dietrich Metal Framing; www.dietrichmetalframing.com
- .6 Georgia-Pacific Canada, Inc.; www.gpgypsum.com
- .7 Gordon Incorporated.; www.gordongrid.com
- .8 Roll Formed Specialty; www.rollformed.com
- .9 Trim-Tex Inc.; www.trim-tex.com
- .10 Unifix Inc.; www.unifixinc.ca

2.02 MATERIALS

.1 Non-Structural Steel Framing Components:

- .1 Galvanized Sheet Steel: ASTM A653/A653M, structural and commercial quality sheets. Treat exposed and finish painted steel components by phosphate conversion process. Provide steel sheet panel for resistance to penetration in gypsum board partitions where scheduled on *Drawings*.
- .2 Hemmed Steel Studs: ASTM C645, Galvanized sheet steel, minimum 0.455 mm (28ga) thickness, zinc coating Z120, screw able with planked web and knurled flange, Flange returns or lips shall have properly hemmed edges. Specialty Hemmed Steel Stud by Bailey Metal Products Ltd; Conform to limiting height table substantiating performance of hemmed section as recommended by manufacturer.
- .3 Steel Studs: ASTM C645, Galvanized sheet steel, minimum 0.836 mm (0.0329 in.)/20 ga) thickness, zinc coating Z275, screw able with crimped web and returned flange, of depth shown in maximum continuous lengths practicable. Provide minimum 0.836 mm (0.0329 in.)/20 ga) or even heavier gauges where required due to height or abuse resistance board.
- .4 Heavy Duty Studs at Openings and Unrestrained Height: ASTM C645, Galvanized sheet steel, minimum 1.519 mm (designation thickness 54mils/minimum base steel thickness 1.367 mm (0.0538 in.)/16 ga) thickness, zinc coating Z275, screw able with crimped web and returned flange, of depth shown in maximum continuous lengths practicable. Provide heavier gauges where unrestrained height exceeds 3600 mm (12').
- .5 Floor and Ceiling Partition Track for Gypsum Board: ASTM C645, Galvanized sheet steel, with minimum 30 mm (1-1/4") legs, top track having longer legs where required to compensate for deflection of structure above. Width to suit metal studs.
- .6 Furring Channels: Galvanized sheet steel, minimum 0.914 mm (designation thickness 3mils/minimum base steel thickness 0.836 mm (0.0329 in.)/colour-White/20 ga) overall thickness zinc coating Z275 screw channels, 67 mm (2-5/8") wide x 22 mm (7/8") deep.
- .7 Screws for Sheet Steel Members: ASTM C954, self-drilling, self-tapping gypsum board screws, 25 mm (1") long #6 for single layer application and as follows:
 - .1 For single layer application over metal framing; self-drilling, self-tapping, case hardened, No. 6 contoured Phillips head or Type S bugle head, sized for minimum 15.9 mm (5/8") penetration into steel framing. All fasteners shall be corrosion resistant. Use drill point screws for abuse resistant gypsum fiber panels.
- .8 Furring anchorages: 1.62 mm (16 AWG) galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C754-07.

.2 Concealed Reinforcing:

- .1 Concealed Sheet Steel Reinforcing: Commercial quality cold rolled galvanized sheet steel to ASTM A653M with zinc

- coating designation of ASTM A653M, Z275 in galvanized sheet steel minimum 1.214 mm (designation thickness 43 mils/minimum base steel thickness 1.087 mm (0.0428 in.)/18 ga); or ASTM A666, Type 304 sheet stainless steel.
- .2 Concealed Metal Stud Reinforcements: Galvanized steel, stud, galvanized sheet steel minimum 1.214 mm (designation thickness 43 mils/minimum base steel thickness 1.087 mm (0.0428 in.)/18 ga) where required to support manufactured components. Prepunched Stud Spacer Bars bridging and spacing bar that facilitates rapid erection of interior, nonload-bearing, nonstructural studs into a rigid, accurately laid out gridwork that provides resistance to stud rotation and displacement, Spazzer® 9200 Spacing Bar by Dietrich Metal Framing.
 - .3 Stud Spacer Bars: Pre-notched bridging and spacing bar that facilitates rapid erection of interior, nonload-bearing, nonstructural studs into a rigid, accurately laid out gridwork that provides resistance to stud rotation and displacement, Spazzer® 9200 Spacing Bar by Dietrich Metal Framing
- .3 Gypsum Board Types:
- .1 Gypsum Board (GB): Conform to ASTM C1396M. Unless indicated otherwise use 15.9 mm (5/8") thick by 1200 mm (4') wide standard facing board in maximum continuous lengths 2400 mm (8'), 3000 mm (10'), up to 3600 mm (12') beveled edges and/or tapered edges to suit design requirements with butted square ends:
 - .1 Gypsum Board (Walls): *Provide* 15.9 mm (5/8") thick with tapered edges unless otherwise specified as follows:
- .4 Miscellaneous Gypsum Board Treatments Trims and Accessories:
- .1 Joint Treatment for Gypsum Board Including Joint Cement, Tape, Topping Compound and Accessories: Conforming to ASTM C475 and gypsum board manufacturer's recommendations. Confirm following *Products* with gypsum board manufacturer prior to application.
 - .2 Dust Barrier: Minimum 0.152 mm (6 mil) polyethylene, CAN/CGSB-51.33-M, Type 2.
 - .3 Resilient Sponge Tape: Self-sticking adhesive on 1 side, closed cell neoprene sponge tape, "Rubatex" by Rubatex Corp. or "Perma-Stik 122X" by Jacobs and Thompson Inc., foamed vinyl "Arnofoam" by Arno Adhesive Tapes Incorporated or "Greyflex Expanding Foam Sealant" by Emseal Corporation.
 - .4 Laminating Compound: Asbestos-free, as recommended by manufacturer. Manufacturer's standard, multi-purpose construction adhesive. Sheetrock brand laminating compound by CGC Inc., or Dehydratine 9T by W.R. Grace and Co., or Stangard Foamastic by Standard Chemicals Ltd. At fire-rated construction, use adhesive which conforms to that used in applicable fire tests.
 - .5 Joint Tape: For regular gypsum board, use either kraft paper joint tape with feathered edges and minute perforations 50 mm (2") wide or glass fibre tape manufactured by CGC and for MRGB or cement board, use glass fibre tape only. For exterior joints, 50 mm (2") and 100 mm (4") widths, Durock Tape, open weave, with pressure sensitive adhesive 1 side; for ProRoc M2Tech use FibaTapeMold X10.
 - .6 Joint Fillers and Topping Compound: Either slow or fast setting, low shrinkage type free of asbestos fillers and as recommended by manufacturer. Use "Gyproc 90" by Georgia-Pacific Canada, Inc. or "Durabond 90" by CGC Inc. at exterior soffits, or "ProRoc 90" by CertainTeed Canada Inc., for ProRoc M2Tech use ProRoc 90 M2Tech Setting Compound.
 - .7 Dust Control Drywall Compound for Joint Fillers and Topping Compound: "Dust Control Drywall Compound" by CGC Inc or "Dust Away" by CertainTeed Canada Inc.; for ProRoc M2Tech use ProRoc 90 M2Tech Ready Mix Compound.
 - .8 For fire rated assemblies setting compound shall be tested in accordance with ASTM E814 and ULC-S115 for required rating. "Gyproc Fire-Halt Sealant Setting Compound" by Georgia-Pacific Canada, Inc.
 - .9 Corner Bead: ASTM C1047, "Dur-A-Bead #114" at corners by CGC Inc. at reveals, or similar. *Provide* custom shapes of similar materials and design as noted.
 - .10 Corner Reinforcement: "ProRoc® AquaBead™ Corner Reinforcement", ASTM C 1047 and C 475. ProRoc® AquaBead™, Class A Flame Spread (<25) and Smoke Developed (<450) in accordance with ASTM E 84. used in conjunction with assemblies of gypsum wallboard to protect edges and corners and to *Provide* architectural features.
 - .11 Metal Trim: BMP D-4411 in lieu of "J" Mould. Do not *Provide* "J" Mould unless specifically noted on *Drawings* as 'Exposed "J" Mould'.

- .12 Paper Faced Metal Bead and Trim: ASTM C1047, accessories used in conjunction with assemblies of gypsum wall board to protect edges, corners and to *Provide* design features including outside bullnose bead; 'J' trim.
- .13 Rigid Vinyl Inside/Outside Corner Fillets: Rigid vinyl incorporating continuous fins for fastening and gypsum board joint compound filling. Punch fins with staggered holes to facilitate screw securement. Ensure vinyl is primed to accept materials associated with wall finishes. *Provide* following components:
 - .1 Inside Corner: R. Bullnose Inside Corner Bead by Trim-Tex Inc. for 38 mm (1-1/2") radius.
 - .2 Outside Corner: R. Bullnose Corner Bead by Trim-Tex Inc. for 38 mm (1-1/2") radius.
 - .3 Splayed Inside Corner: Inside Splayed R. Bullnose Inside Corner Bead by Trim-Tex Inc. for 38 mm (1-1/2") radius.
 - .4 Splayed Outside Corner: Outside Splayed R. Bullnose Corner Bead by Trim-Tex Inc. for 38 mm (1-1/2") radius.
 - .5 Accessories: *Provide* "0913, 0914 and 0915" by Trim-Tex Inc. as required.
- .14 Flexible Casing Beads: 0.51 mm (designation thickness 18mils/minimum base steel thickness 0.455 mm (0.0179 in.)/25 ga) steel, wipe coated, angle shaped in size to fit over edge of gypsum board, to suit curved applications.
- .15 Control Joints: Pre-fabricated control joints prepared to suit site conditions; No. 093 by CGC Inc. zinc alloy control joint.
- .16 Access Doors for Architectural, Mechanical and Electrical:
 - .1 Where supplied by Division 21, 22 23 and 26 shall be installed under this Section.
 - .2 Non-Rated Access Panels: "N/W Series, Flush Non-Rated Access Panels" by Nystrom Building *Products*; www.nystrom.com or "DW-5040" by Acudor *Products* Inc.; www.acudoracornltd.com, or "Van-Met Series" by Mexam Metal *Products*; www.maxammetal.com by Zurn Industries Canada Ltd., or by LeHage Industries Ltd., or by A. G. Baird Limited, or by Stelpro Limited sized to suit design requirements, minimum size 406 mm x 406 mm (16" x 16") with drywall bead frame and key operated cylinder lock. Access panels shall be flush to edge of frame, concealed continuous hinge with screwdriver operated cam latch or key operated cylinder lock to suit design requirements. Non-fire rated shall have 1.9 mm (14 ga) and 1.52 mm (16 ga) frame;

PART 3 EXECUTION

3.01 PARTITION TYPES

- .1 Refer to *Drawings* for partition types.
- .2 *Provide* partitions complete to underside of structure, unless otherwise indicated on *Drawings*.

3.02 EXAMINATION

- .1 Examine substrate for compliance with applicable requirements, installation tolerances and other conditions affecting installation of gypsum board. Do not proceed until unsatisfactory conditions have been corrected. Beginning of installation shall indicate acceptance of substrate conditions.

3.03 PREPARATION

- .1 *Provide* adequate ventilation to eliminate excessive moisture before commencing and during work to ensure proper drying of joint filler and adhesive. Do not force dry adhesive and joint treatment.

3.04 INSTALLATION

- .1 Carry out work using skilled tradesmen carefully supervised by competent foremen. Take all measurements accurately.
- .2 Comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation. *Install* framing, blocking and furring in accordance with ASTM C645, ASTM C1280.
- .3 Maintain wallboard panels minimum 6 mm (1/4") and maximum 13 mm (1/2") above floor to prevent moisture transfer. Extend panels to underside of deck or structure and at fire rated and sound control partitions.
- .4 Erect plain wallboard vertically or horizontally, whichever results in fewer end joints. Locate vertical joints at least 300

- mm (12") from jamb lines of openings.
- .5 Space screws for regular wallboard at 300 mm (12") oc along board edges and in board field on walls; reduce spacing to comply with labeling authorities assembly listings. For other specialty boards screw spacing shall be in accordance with manufacturer's recommendations.
 - .6 Drive screws with power screw-gun and set with countersunk heads slightly below surface of board. Do not secure gypsum board by installing screws into aluminum or steel window and door frames.
 - .7 *Install* resilient sponge tape where wallboard abuts heads or jambs of door and window frames. Adhere tape to casing bead and compress during installation. Compressed thickness; 1.6 mm (1/16").
 - .8 Where framing members are installed against exterior walls or over slab on grade, *Install* asphalt felt strips between studs and substrates such as exterior wall or slab on grade.
 - .9 At partitions except shaft walls, apply 1 continuous 6 mm (1/4") bead of acoustical sealant to each side of partition where gypsum board meets dissimilar materials. Where 2 layers of gypsum board per face are required, apply bead of sealant at perimeter of base layer only.
 - .10 Apply sealant beads at perimeter of all other services and like objects which penetrate wallboard in accordance with manufacturer's directions.
 - .11 *Install* access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services. *Consultant* reserves right to relocate access panels up to 3600 mm (12') from locations shown on *Drawings* due to site conditions, providing ample warning is given prior to installation.
 - .12 *Provide* access panels in locations and sizes required by other Sections. Coordinate with other Sections for locations and sizes. *Install* in accordance with manufacturer's instructions.
 - .13 Metal Framing for Partitions:
 - .1 Comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation and recommendations of CGC Drywall Steel-Framed Systems for metal stud partitions.
 - .2 *Install* members true to lines and levels and to maintain surface flatness with maximum variation of 3 mm (1/8") in 3000 mm (10'-0") in any direction.
 - .3 *Provide* partition tracks at floor and underside of structure above. Align accurately. Lay out to partition layout.
 - .4 *Install* stud spacer bars specified herein as required to restrain studs against lateral and torsional movement, and to *Provide* supplementary horizontal bracing.
 - .14 *Provide* heavy duty double boxed studs at each side of openings to extend in 1 piece from floor to underside of structure above.
 - .15 Co-ordinate erection of studs and installation of service lines.
 - .16 *Provide* continuous gasket to separate metal framing from masonry and concrete.
 - .17 *Provide* continuous gasket between floor tracks and structure.
 - .18 Concealed Reinforcements in Partitions:
 - .1 *Provide* hollow structural steel, stud, angle and steel plate sections, galvanized sheet steel as specified herein before where required to support manufactured components. Weld connections. Ensure rigid and secure installation capable of offering resistance to minimum 227 kg (500 lbs) pull force. Galvanize stud reinforcements in moist areas. Do not use wood blocking for this purpose.
 - .2 Concealed Sheet Steel Reinforcing: *Provide* galvanized sheet steel minimum 1.214 mm (designation thickness 43mils/minimum base steel thickness 1.087 mm (0.0428 in.)/18 ga) where required to support manufactured components. *Provide* sheet plate, steel stud, angle and other accessories to complete reinforcement.
 - .3 Concealed Metal Stud Reinforcement: *Provide* Galvanized steel, stud, galvanized sheet steel minimum 1.214 mm (designation thickness 43mils/minimum base steel thickness 1.087 mm (0.0428 in.)/colour-yellow/18 ga) where required to support manufactured components. Ensure studs reinforcements are galvanized in moist areas. *Provide* stud bridging and spacing bars to facilitate rapid erection.
 - .4 Ensure rigid and secure installation capable of offering resistance to minimum 227 kg (500 lbs) pull force. Do not use wood blocking for this purpose. *Provide* additional reinforcing framing studs or furring channels secured between studs for attachment and support without limitations following:

- .1 access panels.
 - .2 architectural woodwork.
 - .3 miscellaneous specialties.
 - .4 fitments and fixtures.
 - .5 wall mounted equipment.
 - .6 Cooperate and coordinate reinforcement requirements with those sections
 - .7 requiring concealed reinforcements in partitions.
- .19 Provide continuous horizontal furring channels as backing to wall cabinets.
- .20 Access Doors and Panels: *Install* access doors and panels supplied as part of work of Divisions 21, 22, 23 and 26 and where required as part of work of this Section in walls.
- .21 Metal Furring:
- .1 Erect furring in accordance with manufacturer's directions and as specified herein.
 - .2 Provide furring rigid, secure, square, level or plumb, framed and erected to maintain finish dimensions and contours indicated. Allow for thermal movement.
 - .3 Furr around ducts and pipes in finished areas.
 - .4 Provide metal furring channels fastened to masonry or concrete surfaces in parallel rows at 400 mm (16") oc unless gypsum board is indicated to be adhered directly to masonry or concrete surfaces. Shim metal furring channels to Provide a level surface.
- .22 Gypsum Board Application:
- .1 Provide gypsum board in accordance with manufacturer's written installation instructions and finish to requirements of ASTM C840. Ensure moisture resistant gypsum board is installed on any wall/partition containing a plumbing fixture (i.e. water closets, sinks, tubs, etc.).
 - .2 Provide metal trim casing bead at junctions with dissimilar materials. Provide reveals at junctions with dissimilar materials where indicated.
 - .3 Provide finished work plumb, level and true, free from perceptible waves or ridges and square with adjoining work.
 - .4 Cut and fit gypsum board to accommodate or fit around other parts of Work. Provide work of this Section accurately and neatly.
 - .5 Butt gypsum board sheets together in moderate contact. Do not force into place. Place tapered or wrapped edges next to 1 another.
 - .6 Support ends and edges on framing.
 - .7 Fasten gypsum board to metal furring and metal studs with screws. Space screws at 200 mm (8") oc at board edges and 300 mm (12") oc on board field. Ensure perimeter screws are not less than 9 mm (3/8") nor more than 13 mm (1/2") from edges and ends are opposite screws on adjacent boards.
 - .8 Gypsum Board - Single Layer:
 - .1 Partitions: Apply gypsum board to metal studs with screws. Erect board with long dimension parallel to supports. Locate end joints over supporting members. Locate vertical joints at least 300 mm (12") from jamb lines of openings. Space screws at 200 mm (8") oc at board edges and 300 mm (12") oc on board field.
 - .2 Partition Fasteners: Ensure perimeter screws are not less than 9 mm (3/8") nor more than 13 mm (1/2") from edges and ends are opposite screws on adjacent boards. Drive screws with power screw gun and set with countersunk head slightly below surface of board.
 - .3 Joints: Finish all joints unless specified otherwise.
- .23 Gypsum Board Laminated to Clay Tile Masonry:
- .1 Base shall be straight, dry uncoated, clean and free from efflorescence.
 - .2 Mix laminating adhesive in accordance with manufacturer's directions. Allow to stand 30 minutes before using.
 - .3 Apply adhesive with notched trowel to leave 9 mm x 13 mm (3/8" x 1/2") ribbons, 32 mm (1- 1/4") apart over entire back side of face layer.
 - .4 Erect gypsum board immediately after spreading adhesive. Use moderate pressure to develop full adhesive contact with substrate.
 - .5 Temporarily secure gypsum board in place with concrete nails or bracing. Ensure joints are accurately aligned. Avoid impact or movement of boards until adhesive sets firmly. Remove temporary support when

- adhesive has set.
- .6 Do not treat joints of laminated gypsum board for at least 24 hrs after lamination.
- .24 Metal Trim and Accessories:
- .1 Provide metal trim casing beads at reveals; at partition perimeters; and at intersection of dissimilar constructions such as gypsum board to concrete.
- .2 Provide metal trim casing beads where gypsum board abutts against a surface having no trim concealing junction.
- .3 Provide paper faced metal bead and trims for outer and inner corners, L trim, cut to suit design, aligned, using setting and finishing compound in accordance with manufacturer's recommendations. Sand lightly where necessary prior to applying finishing coat. For mechanical fastening use paper faced nail on bead and trim. *Install* by using commercial staples and screws. Finish as specified herein.
- .4 Provide a 13 mm (1/2") separation gasket between metal trim casing beads and window frames or other cold surfaces or Provide sponge tape between gypsum board partition or furring framing, where such framing abuts exterior door or window frame. sponge tape between floor and gypsum board partition track. Tape shall be either full width or 1 strip 9 mm (3/8") wide on each side of framing member.
- .25 Control Joints:
- .1 Provide pre-fabricated, pre-manufactured control joints and/or prepared to suit site conditions control joints and in accordance with manufacturer's instructions and in accordance with ASTM C840.
- .2 Set in gypsum facing board, supporting control joints with studs or furring channels on both sides of joint. Provide control joints at following locations:
- .1 support construction changes.
- .2 partition or furring runs exceed 9000 mm (30').
- .3 Provide continuous polyethylene dust barrier behind and across control joints.
- .4 Obtain *Consultant's* acceptance of exact locations of control joints.
- .26 Joint Treatment - Gypsum Board:
- .1 Verify board is firm against framing members and screw heads are properly depressed.
- .2 Mix joint compound or ready-to-use compounds according to manufacturer's directions. Use pure, unadulterated, clean water for mixing. Permit mixed material to stand 30 minute before using. Do not mix more material than can be used within 1 hour. Do not use set or hardened compound. Clean tools and equipment after mixing each batch.
- .3 Tape and fill joints and corners in accordance with gypsum board manufacturer's printed instructions. Fill either manually, using hand tools of trade, or by mechanical taping and filling machine of proven efficiency. Apply thin layer of compound to tapered edge. Press joint tape firmly into compound, while centering it over the seam and embed with a broad knife. Sufficient drywall compound shall remain under tape to ensure proper bond. Allow to dry. Apply a second coat of drywall compound over embedding coat and feather out beyond first coat. Allow second coat to dry thoroughly prior to application of finish coat. Spread finish coat evenly over second coat and feather to a smooth uniform finish. After each coat has dried, sand or sponge smooth prior to application of ensuing coat. Remove plastic tape from control joints after finishing with joint compound. After final coats of filler have dried at decoration. Provide finished work smooth, seamless, plumb and true, flush and with square plumb neat corners.
- .4 Level of Finish: Provide Level 5 level of finish in accordance with ASTM C840.

3.05 CLEANING

- .1 Clean off beads, casings, joint cement droppings and similar items and remove surplus materials and rubbish on completion and as directed.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

- .1 This section includes labor, materials and other services necessary to complete slip resistant sheet vinyl safety flooring systems and accessories work. Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the work of this Section.

1.02 RELATED SECTIONS

- .1 Section 06 10 00 - Rough Carpentry

1.03 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - .2 ASTM E 648/NFPA 253, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - .3 ASTM E662, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - .4 ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - .5 ASTM F 970, Standard Test Method for Static Load Limit.
 - .6 ASTM F1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring.
 - .7 ASTM F1303, Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - .8 ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
 - .9 (RFCI) Resilient Floor Covering Institute
 - .1 RFCI Standard Slab Moisture Test Method (Calcium Chloride Method)

1.04 SUBMITTALS

- .1 Submit each item in this Article in accordance with Division 1.
- .2 Product Data: Submit manufacturer's technical data and installation recommendations for each type of flooring and accessory products specified.
- .3 Shop Drawings:
 - .1 Submit shop drawings showing layout, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - .2 Show details of profiles and product components, including anchorage, accessories, finish colors, patterns and textures.
- .4 Samples: Submit two (2) sets of samples of each type, color and finish of flooring and accessory products specified, with an indication of full range of color, pattern and texture variation. Provide samples with a minimum size of 150 mm x 200 mm for flooring products and 150 mm in length for accessories.
- .5 Quality Assurance Submittals:
 - .1 Submit manufacturer's Product Technical Data Sheet, specifying performance characteristics, criteria and physical requirements.
 - .2 Submit manufacturer's written installation recommendations.
- .6 Closeout Submittals:
 - .1 Submit maintenance and operations data in accordance with Division 1 Closeout Submittals Section. Include methods

- for maintaining the installed products and any precautions against cleaning materials or methods that are detrimental to the product and their performance.
- .2 Submit warranty as specified herein.
- .3 Installer Certification: Submit proof of certification from the manufacturer certifying that the installers comply with the specified requirements.
- .7 Replacement Material: After completion of work, deliver to project site replacement materials from the same manufactured lot as materials installed. Package materials with protective covering and identify each with descriptive labels.
 - .1 Flooring Materials: No less than 3 square meters of each type, pattern and color installed.

1.05 QUALITY ASSURANCE

- .1 Manufacturer: Whenever possible, provide each type of flooring as provided by a single manufacturer, including recommended primers, adhesives, sealants, patching and leveling compounds.
- .2 Flooring Contractor Qualifications:
 - .1 The awarded flooring contractor shall be an established firm, experienced in the installation of the specified product and shall have access to all manufacturer's required specifications, technical, installation and maintenance related documents.
- .3 Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 - .1 Training: Installer who has attended an Altro flooring installation training clinic.
- .4 Regulatory Requirements: Provide sheet vinyl flooring in compliance with the following:
 - .1 Americans with Disabilities Act Architectural Guidelines (ADAAG).
 - .2 Occupational Safety & Health Administration (OSHA).
- .5 Mock-ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing.
 - .1 Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
 - .2 Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.
- .6 Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, manufacturer's warranty requirements, and installer qualifications.

1.06 WARRANTY

- .1 Project Warranty: Comply with requirements according to the "Conditions of the Contract" in Division 1 Closeout Submittals Warranty Section for project warranty provisions.
- .2 Manufacturer's Warranty: Submit the manufacturer's standard warranty document executed by authorized company official for Owner's acceptance. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - .1 Warranty Period: Warranty period for Altro Symphonia shall be 10 years commencing on date of substantial completion. Refer to conditions of the contract for project warranty provisions
- .3 Installation Warranty: Submit the flooring contractor's installation warranty signed by the General Contractor and Installer for Owner's Acceptance, agreeing to repair or replace work which has failed as result of defects in workmanship. Failure shall include, but not limited to, tearing, cracking, separation, deterioration or loosening from substrate, seam failure, ripples, bubbling or puckering. Upon notification of such installation deficiencies, within the warranty period, make necessary repairs or replacement at the convenience of the Owner. Other guaranties or warranties may not be substituted by the Contractor for the terms of this warranty. Installation warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents

- .1 Warranty Period: Two (2) year limited warranty commencing on Date of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- .1 General: Comply with the Division 1 Product Requirements Sections.
- .2 Ordering: Comply with the manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- .3 Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .4 Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
 - .1 All materials (flooring, adhesives, weld rod and accessories) should be stored in areas that are fully enclosed and weather tight. The permanent HVAC should be fully operational and controlled and set at a minimum temperature 65° F (18° C). If this is not possible, the areas should be acclimated and controlled by means of temporary HVAC to the service level conditions expected during occupancy. The temperature and humidity should range from 75° F ± 10°F (23.9° C ± 5.5° C) with a 50% ± 10% ambient relative humidity. For further information refer to current Altro Installation Practices and Quick Facts.
 - .2 Store rolls standing upright, labels up, and ensure that the color, roll and batch numbers can be easily read.
 - .3 Comply with the manufacturer's recommendation for the acclimation of all materials in the space where they will be installed for at least 72 hours prior to the installation unless longer conditioning periods are required by the manufacturer.

1.08 BACKING

- .1 Altro Symphonia uses non-woven polyester/cellulose, glass fiber reinforcement.

1.09 PROJECT CONDITIONS

- .1 Environmental Requirements/Conditions:
 - .1 Areas to receive material should be clean, fully enclosed and weather tight. The permanent HVAC should be fully operational and controlled and set at a minimum temperature 65° F (18° C). If this is not possible, the areas should be acclimated and controlled by means of temporary HVAC to the service level conditions expected during occupancy. The temperature and humidity should range from 75° F ± 10°F (23.9° C ± 5.5° C) with a 50% ± 10% ambient relative humidity. These conditions MUST be established at least seven days prior to beginning the installation, maintained during the installation, and continued for at least seven days following the installation.
 - .2 The flooring material should be conditioned in the same manner for at least 72 hours prior to the installation.
 - .3 Substrate evaluation and preparation should not begin until a stable, conditioned environment has been established as described in this section.
 - .4 Areas to receive flooring must have adequate lighting to allow for proper inspection and preparation of the substrate, installation of the flooring and final inspection.
- .2 Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.
 - .1 Temperature Conditions: 65° F (18° C) for at least seven days prior to beginning the installation, maintained during the installation, and continued for at least seven days following the installation.
- .3 Substrate Conditions:
 - .1 Close spaces to traffic during flooring installation and for time period after installation recommended in writing by the manufacturer.
 - .2 Installation should not begin until the work of all other trades has been completed, especially overhead trades.
 - .3 Where demountable partitions and other items are indicated for installation on top of flooring material, install flooring material before these items are installed.

- .4 Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- .1 ALTRO FLOORING SYSTEMS
Address: 6221 Kennedy Road, Unit 1, Mississauga, ON, L5T 2S8, Phone: 416-428-3964, www.altro.com,
support@altro.com
- .2 Substitutions: Not Permitted.

2.02 MATERIALS

- .1 Material Name: Altro Symphonia Resilient sheet flooring
- .2 Description: Altro Symphonia is a hybrid floor that bridges the gap between smooth and slip resistant. It's a perfect choice when cleaning is essential, but some degree of slip resistance is still needed.
- .3 Wear Layer: 8mm (32 mil)
- .4 Width: 2 Meters (6'7")
- .5 Length: 20 Meters (65'5")
- .6 Gauge: 2.0mm (0.080")
- .7 Color and Pattern: Colors and patterns as indicated on the Drawings.
- .8 Adhesive: AltroFix 30/ as per manufacturer's recommendation.
- .9 Seams: All Symphonia sheet products shall be installed utilizing net fit seams and heat welded the day following installation.
- .1 Welding Rod: Altro Weldrod™ as selected by Architect from manufacturer's standard patterns and colors.
- .2 Adhesives: As per manufacturer's recommendation.

2.03 ACCESSORIES

- .1 Cove former: Acceptable material, sized to suit application:
- .1 Altro Cove former 20R - 24 mm (1") radius.
- .2 Cap strip: Acceptable material, sized to suit application, stainless steel:
- .3 Subfloor Filler and Leveler: Use only gray Portland cement-based "moisture tolerant" underlayments, and patching compounds. Use for filling cracks, holes or leveling. White gypsum materials are not acceptable.
- .4 Metal edge strips:
- .1 Stainless steel extruded, smooth, with lip to extend over flooring.
- .5 Adhesives:
- .1 Adhesives as recommended by resilient flooring manufacturer.

PART 3 EXECUTION

3.01 MANUFACTURER'S RECOMMENDATIONS

- .1 Compliance: Comply with manufacturer's product technical datasheet, including product technical bulletins, installation recommendations, and guide and floor care recommendations.

3.02 INSPECTION

- .1 Site Verification of Conditions: The Flooring Contractor and Installer shall examine and verify conditions previously described in other sections under which flooring and accessories are to be installed to be in accordance with the manufacturer's installation recommendations and must notify the General Contractor in writing of conditions detrimental to proper and timely completion of work. Work shall not proceed until all unsatisfactory conditions are corrected to acceptable conditions to the Owner and Architect.
- .2 Material Inspection: Visually inspect all materials prior to installation in accordance with the manufacturer's installation recommendations. Material with visual defects shall not be installed and shall not be considered as a legitimate claim if they are installed.

3.03 PREPARATION

- .1 General: Comply with manufacturer's written installation recommendations for preparing substrates indicated to receive flooring products and accessories. Flooring shall be installed over subfloors conforming to ASTM F710 for concrete and other monolithic floors or ASTM F1482 for wood subfloors.
- .2 Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
- .3 Surface Preparation:
 - .1 General: Prepare substrate in accordance with manufacturer's recommendations and ASTM industry standards. Work shall not proceed until all unsatisfactory conditions are corrected to acceptable conditions to the Owner and Architect.
 - .2 Substrate: Substrates to receive flooring must be structurally sound, rigid, smooth, flat, clean, and permanently dry. The substrates must be free of all foreign materials including, but not limited to, dust, solvent, paint, wax, oils, grease, residual adhesive, adhesive removers, film-forming curing compounds, silicate penetrating curing compounds, sealing, hardening or parting compounds, alkaline salts, excessive carbonation or laitance, mold, mildew, and other foreign materials that might affect the rate of moisture dissipation from the concrete, the adhesion of flooring to the concrete or cause a discoloration of the flooring from below.

3.04 INSTALLATION

- .1 Symphonia Installation: Install Altro flooring in accordance with the current posted Altro Installation Practices and Quick Facts Guide. All Seams shall be heat welded with Altro Weldrod™ only. Failure to install Altro flooring in accordance with recommended procedures will void the Altro Limited Product Warranty.
- .2 Adhesive Application: Use trowel recommended by flooring manufacturer for adhesive.
- .3 Coved Installation: Extend the flooring up the wall in a flash-coved method to a height of 102 mm (4 inches). Where Altro flooring is coved up wall surfaces and other abutments, installation shall be in accordance with Altro flooring Installation Practices using the following accessories:
 - .1 At standard wall finishes: Use Altro stainless steel cap strip to accommodate sheet vinyl to a height as indicated.
 - .2 At ceramic tile, Altro Whiterock semi-rigid wall cladding or FRP paneling: Use Altro C8 Vinyl Captile Strip or C4 cap, respectively.
 - .3 At 0.75" (19.1 mm) radius coving at juncture of vertical and horizontal surfaces: Use Altro Vinyl Cove Former 20R.
 - .4 Top set cove base: Install in accordance with manufacturer's instructions.
- .4 Installation Techniques:
 - .1 Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
 - .2 Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures and built-in furniture, including pipes, outlets, edgings, thresholds, nosings, and cabinets.
 - .3 Extend flooring into toe spaces, door reveals, closets, and similar openings.

- .4 Adhere resilient flooring to substrate without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed installation.
 - .1 Use adhesive applied to the substrate in compliance with the flooring manufacturer's recommendations, including those for proper spreading of the adhesive, adhesive missing and adhesive open and working times.
- .5 Immediately roll the flooring in all directions using a 100 lb. roller to ensure proper adhesive transfer. Additional rolling is required during adhesive setup to ensure that the material is flat and fully adhered. The use of a three-section wall roller or steel seam roller is required at walls, under toe kicks or anywhere the full weight of a 100 lb. roller cannot access or be applied.

3.05 PROTECTION

- .1 Protection: Do not allow heavy traffic or rolling loads for at least 72 hours following the installation. Additional time may be necessary if the installation is over a non-porous substrate.
- .2 Cover and protect finished installation from damage from other trades using a non-staining, temporary floor protection system, such as a reusable textured plastic sheeting. Symphonia should be covered and protected from all other trades during construction with a suitable non-staining protective covering without taping to the surface of the flooring.

3.06 CLEANING

- .1 Initial Maintenance: In order to allow the adhesive to dry and cure properly, wait a minimum of five days following the installation before conducting wet cleaning procedures or initial maintenance. Additional time may be necessary if the installation is over a non-porous substrate.
- .2 Procedure:
 - .1 Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's recommendations prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.
 - .2 Remove visible adhesive and other surface blemishes using cleaning methods recommended by floor manufacturer.
 - .3 Remove all surface soil, debris, sand and grit by dust mopping, sweeping or vacuuming the floor with Altro Clean 44 using an auto scrubber.
 - .4 Rinse the entire floor surface with a clean mop using clean, cool water.
 - .5 Allow the floor to dry thoroughly before allowing traffic.

END OF SECTION

PART 1 GENERAL

1.01 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 University of Toronto Additional General Requirements of the Contract
 - .2 Division 1 requirements and documents referred to therein.

1.02 SUMMARY

- .1 Work Included: *Provide* resilient base including but not limited to following:
 - .1 Surface fillers, primer and adhesive.
 - .2 Resilient bases.

1.03 REFERENCE

- .1 Reference Standards:
 - .1 ASTM E662-13: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - .2 ASTM F1861-08: Standard Specification for Resilient Wall Base
 - .3 CAN/ULC S102.2-10: Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.04 SUBMITTALS

- .1 *Shop Drawings*: Submit *Shop Drawings* indicating material characteristics, details of construction, connections and relationship with adjacent construction.
- .2 Samples: Submit 2 representative samples for *Consultant's* approval of each material specified indicating visual characteristics and finish prior to ordering. Include range of samples if variation of finish is anticipated.

1.05 QUALITY ASSURANCE

- .1 Applicator Qualifications: Contractors for floor covering installation should be experienced in managing commercial flooring projects and provide professional installers, qualified to install the various flooring materials specified. An installer is "qualified" if trained, or a certified by manufacturer or a certified INSTALL (International Standards & Training Alliance) resilient floor covering installer. Upon request, provide proof of manufacturer's certificate to Consultant prior to commencement of installation.
- .2 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in good condition to site in manufacturer's original unopened containers that bears name and brand of manufacturer, *Project* identification, shipping and handling instructions.
- .2 Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C) for period of 48 hours immediately prior to, during and after installation. Store goods in rolls only.

1.07 PROJECT CONDITIONS

- .1 Install resilient products after other finishing operations, including painting, have been completed.
- .2 Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products during the following time periods:
 - .1 48 hours before installation.

- .2 During installation.
- .3 48 hours after installation.
- .3 Maintain the ambient relative humidity between 40% and 60% during installation.
- .4 Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

1.08 WARRANTY

- .1 Warranty resilient bases for a period of 3 years from date of *Substantial Performance of the Work* against defects and/or deficiencies in accordance with General Conditions of the *Contract*. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of *Consultant* and at no expense to *Owner*. Defects include but are not limited to; failure in adhesive bond and extensive colour fading.

1.09 MAINTENANCE

- .1 Extra Materials: *Supply to Owner* at completion of job three 6000 mm (20'-0") of pieces of stock of each type of resilient base in colours specified for future repairs, boxed in original containers and clearly labeled. Extra stock shall be same production run as installed *Products*. Store extra stock in location as directed later by *Consultant*.
- .2 72 hours after installation is completed, initial maintenance procedures must be implemented in accordance with manufacturer's requirements. Refer to the Rubber Vinyl Wall base Installation & Maintenance instructions for full details.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- .1 TARKETT JOHNSONITE
 - .1 Representative Contact: Victoria KITELEY, Tarkett, Account executive
Tel: (416) 770-2319 Email: Victoria.Kiteley@tarkett.com

2.02 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Surface burning characteristics: Provide Product with following flame spread rating and smoke developed rating when tested in accordance with following standards:
 - .1 Critical Radiant Flux (ASTM E648): > 0.45 watts/cm² – Class I
 - .2 Smoke Developed (ASTM E662): ≤ 450
 - .3 CAN/ULC-S102.2-M: Maximum Flame Spread: 100.

2.03 MATERIALS

- .1 Traditional Vinyl with Toe
 - .1 Thickness: Minimum 3.175 mm (1/8") thick
 - .2 Height: 100 mm (4").
 - .3 Lengths: Coils in manufacturer's standard length
 - .4 Corners: Job-formed using adhesive, cove former fillet radius reinforcing strips, welding rod and accessories as recommended by resilient base manufacturer.
 - .5 Colors: As indicated on the Drawings from manufacturer's full range including designer colours.
- .2 Surface fillers and primers: Types and brands approved, acceptable to resilient base manufacturers for applicable conditions. Use non-shrinking latex compound.
- .3 Resilient base adhesives: Best quality, waterproof, clear setting type and brands as recommended by resilient base

manufacturer and meeting VOC limits stipulated herein.

- 4 Joint Sealant: Provide CAN/CGSB-19.24-M, multi-component modified urethane base chemical curing sealing material compatible with adjacent materials finish and as recommended by resilient base manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- .1 Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- .2 Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- .1 Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient wall base.
- .2 Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- .3 Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- .4 Vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 INSTALLATION

- .1 Resilient base work shall be performed by experienced and competent workers in strict accordance with manufacturers written instructions for material concerned.
- .2 Set wall base in adhesive tightly against wall and floor surfaces. Use lengths as long as practicable and not less than 500 mm (20") long.
- .3 *Install* resilient bases to walls and fitments as indicated on the *Drawings* and Room Finish Schedule, during final stages of completion of work, when ceilings and permanent partitions are finished, when prime paint coats are applied and when surface conditions are suitable for installation.
- .4 Set resilient base in adhesive to produce a positive, permanent bond without gaps, tight against vertical and floor surfaces for a uniform fit.
- .5 *Install* resilient base straight and level with maximum height variation of 1:1000, having vertical, tight and flush "hairline" butt joints with no two joints closer than 2' - 0" (610mm) apart.
- .6 Ensure that installation of resilient base is tight, firm, and free of bubbling and separation of any kind from surfaces. Remove defective installation as directed by *Consultant* and *Install* new resilient base as specified herein.
- .7 Resilient base work shall be handed over to *Owner* free of blemishes and in perfect condition.
- .8 Job-Formed Corners:
 - .1 Accurately scribe and fit resilient base to metal frames and other obstructions.
 - .2 Outside Corners: Use straight pieces of maximum lengths possible. External corners shall be wrapped around corners as sharp as possible by scoring the back. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - .3 Inside Corners: Provide mitred internal corners. Use straight pieces of maximum lengths possible. Shave back of base where necessary to produce a snug fit to substrate.

3.04 CLEANING

- .1 Remove excess adhesive from floor, base and wall surfaces without damage.
- .2 Clean, seal and wax floor and base surface to flooring manufacturer's instructions.

3.05 PROTECTION

- .1 Protect installed flooring as recommended by flooring manufacturer against damage from rolling loads, other trades or placement of fixtures and equipment.
- .2 Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

PART 1 GENERAL

1.01 REFERENCES

- .1 Environmental Protection Agency (EPA) - EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24, (for Surface Coatings).
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS).
- .3 Master Painters Institute (MPI) - MPI Architectural Painting Specifications Manual.
- .4 Society for Protective Coatings (SSPC) - Painting Manual, Volume One and Two.
- .5 Transport Canada (TC) - Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.02 QUALITY ASSURANCE

- .1 Qualifications: *Provide* work of this Section executed by competent installers with membership in good standing in OPCA and/or PDCA and have a minimum of 5 years experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Ensure materials, preparation and workmanship conforms to requirements of the MPI Painting Manual requirements and inspected by local MPI Accredited Quality Assurance Association's Paint Inspection Agency inspector.

1.03 SUBMITTALS

- .1 Product Data: Submit manufacturer's *Product* data sheets, include product characteristics, performance criteria, physical size, finish, limitations and installation instructions for each material and *Product* used.
- .2 Samples: 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. Identify each sample as to *Project*, finish, formula, colour name, number, gloss name and number, date and name of Contractor and painting Subcontractor.
- .3 Extra Materials: *Supply to Owner* 1-4 litre can (1-1 gal) of each different type and colour of paint used on this *Project*. Paint shall be boxed and in sealed, unopened cans in undamaged condition, with name of manufacturer, contents, type and colour clearly indicated on a label securely adhered to can. Submit cans to Owner in accordance with requirements of Section 01 77 00.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in sequence to meet installation schedule. *Provide* protection from marring or other damage.
- .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.
- .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.

1.05 PROJECT CONDITIONS

- .1 Do not apply materials when surface and ambient temperatures or relative humidity are outside ranges required by paint manufacturer.
- .2 Maintain ambient and substrate temperatures above manufacturer's minimum requirements for 24 hours before, during, and after paint application.
- .3 Do not apply materials when relative humidity is above 85 percent or when dew point is less than 5 degrees F different than ambient or surface temperature.
- .4 Provide lighting level of 320 lux (30 footcandles) at substrate surface.
- .5 Paint and finish work items in clean, dust-free, properly ventilated and adequately lit areas (minimum 100 lx (9.3 ft candles)).
- .6 Maintain minimum interior temperature of 18 deg C (65 deg F) during application and drying of paint and maintain until building occupancy occurs.
 - .1 Do not Provide paint under ambient and surface temperatures less than 15 deg C (59 deg F) in any instance for 24

- hours before and during installation; and 7 Days after installation.
- .2 Provide ventilation to remove odours, evaporating solvents and moisture. Maintain adequate ventilation at all times to control excessive humidity.
 - .3 Ensure adequate temporary ventilation is provided for protection of workers from toxic fumes.

PART 2 PRODUCTS

2.01 MATERIALS

- .1 Only materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc.) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project. All such material shall be from a single manufacturer for each system used.
- .2 Other materials such as linseed oil, shellac, thinners, solvents, etc. shall be the highest quality product of an MPI listed manufacturer and shall be compatible with paint materials being used as required.
- .3 All materials used shall be lead and mercury free and shall have low VOC content where possible.

2.02 MIXING AND TINTING

- .1 Unless otherwise specified herein or pre-approved, all paint shall be ready-mixed and pre-tinted. Re-mix all painting containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and color and gloss uniformity.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

2.03 DESCRIPTION

- .1 Design and Performance Criteria:
 - .1 Acceptable materials, workmanship and all items affecting the Work of this Section are to be in accordance with the Master Painter's Institute "Architectural Painting Specification Manual", (MPI) latest edition, and "Maintenance and Repainting Specification Manual", latest edition.
 - .1 Painting work to be in accordance with MPI Premium Grade finish requirements.
 - .2 Provide following paint systems for various substrates indicated herein. Provide listed prime and finish coat materials unless otherwise recommended by paint manufacturer in writing for each specific substrate.
 - .3 Provide paint and finishing materials of highest grade, top of line quality of manufacturer.
 - .4 Provide primers in recommended dry film thicknesses per coat (DFT/coat).
 - .5 Only materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc.) listed in the MPI Approved Product List are acceptable for use on this Project.
 - .6 Provide other materials such as linseed oil, shellac, thinners, solvents, etc. of the highest quality Product of an MPI listed manufacturer and compatible with paint materials being used as required.
 - .7 Provide paint materials with good flowing and brushing properties and dry or cure free of blemishes, sags, air entrapment, etc.
 - .8 Where required, ensure paints and coatings meet flame spread and smoke developed ratings designated by local Code requirements and authorities having jurisdiction.
 - .9 Paint applied on materials which from time to time will become hot, such as convector covers and similar items, to be approved by paint manufacturer for particular condition.
 - .10 As far as practical, factory mix paint for immediate application without thinning or alteration at site. Do not alter or thin any paint without manufacturer's written approval.

- .11 Consultant reserves right to refuse paint or finishing material if in Consultant's opinion materials are not suitable or adequate for proposed use.

2.04 GLOSS LEVELS

- .1 Gloss and Sheen Ratings: Gloss terms to have following values in accordance with ASTM D523 based on MPI recommended gloss reflectance guidelines:

<u>Gloss Term</u>	<u>Gloss Level</u>	<u>Gloss Value</u>
Flat or Matte	G1	0 to 5 units at 60 degrees and max 10 units at 85 degrees
Velvet	G2	0 to 10 units at 60 degrees and 10-30 units at 85 degrees
Eggshell	G3	10-25 at 60 degrees and 10-30 units at 85 degrees
Satin	G4	20 to 35 units at 60 degrees and min 35 units at 85 degrees
Semi-Gloss	G5	35 to 70 units at 60 degrees
Gloss	G6	70 to 85 units at 60 degrees.

- .2 Colours: Refer to Room Finish Plan.

- .1 Maximum of 6 colours, of which no more than 3 colours will be dark accent colours. No more than 3 colours will be used per room for walls and ceilings, with a different colour for painted doors and frames. Deep tint accent colours may be used on doors and similar panels scheduled for painting.
- .2 Reveals, coves and bulkheads and valances may have colour different than main colour in room.

PART 3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Surface Conditions:

- .1 Do work only when surfaces and conditions are satisfactory for production of quality work. Report to *Consultant* in writing any surfaces which are found to be unsatisfactory. Commencement of work implies acceptance of substrate surfaces.

3.02 PREPARATION

- .1 Verify each substrate is dry and not frozen and free from tool and sandpaper marks, dust, rust, insects, grease and other foreign matter liable to impair finished work.
- .2 Prepare defective surfaces to obtain a satisfactory substrate and in accordance with paint manufacturer's instructions.
- .3 Prior to painting, sweep areas dust-free.
- .4 Clean soiled surfaces to be painted.
- .5 Protection:
- .1 *Provide* scaffolding, staging, platforms and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with Occupational Health and Safety Act.
- .2 *Provide* drop cloths or adequate plastic sheets to protect floors in areas assigned for storage and mixing of paints.
- .3 Protect work of other trades against paint splattering and *Make Good* at own expense any such damage.
- .4 Remove finish hardware, electrical switch and outlet covers, receptacle plates, fittings and fastenings, to protect from paint splatter. Mask items not removable. Use sufficient drop cloths and protective coverings for full protection of floors, furnishings, mechanical, electrical and special equipment, all other components of building which do not require painting or to be removed, from paint spotting and other soiling. Re-Install items when paint is dry. Clean any components that are paint spotted or soiled.
- .5 Keep waste rags in covered metal drums containing water and remove from building at end of each *Day*.

- .6 Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured. Post "wet paint" or other warning signage during and on completion of work. *Provide* also warning signs at all points of entry to areas where painting is applied.
- .7 When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do not *provide* protection from vapours.
- .6 Surface Preparation:
 - .1 Remove dust, grease, rust and extraneous matter from surfaces (except rust occurring on items specified to be primed under other Sections shall be removed and work reprimed under those Sections). Vacuum (fibre acoustic tile and) insulation covering surfaces. Vacuum clean floors before painting; wipe clean adjacent surfaces and surfaces to be painted before work is commenced to prevent dust and debris damage to wet paint.
 - .2 Remove mildew growth by scrubbing affected area with solution of tri-sodium phosphate (TSP) (150 g) and/or household bleach (125 g) in 3.5 L water. Rinse well with clean water and allow to dry. If condition is serious then notify Consultant and installed work shall be considered defective and shall be removed at Contractor's expense. Contractor shall be responsible to retain a qualified and experienced bio-contamination investigator acceptable to Consultant to conduct at its expense sampling and laboratory analysis and other required assessment steps to determine whether or not materials are impacted by mould amplification and follow up recommended contamination management method.
 - .3 Be responsible for surface preparation to suit surface condition and conform to level of cleaning based on SSPC, recommended metal cleaning procedures most commonly used to suit site conditions. Take measure to change rags frequently to prevent spread of contaminants. Do final water cleaning prior to water based paint applications.
 - .4 Ferrous Metal: Clean to SSPC-SP1/2/3 described herein, to suit site conditions. Remove loose rust and prime bare metal with rust inhibitive steel primer. Touch-up damaged shop applied primer using compatible *Product*. *Provide* full coat primer only if damage is extensive.
 - .5 Miscellaneous Steel (previously painted and exposed by alterations work): Remove oil, grease, dirt, rust scale, loose mill scale, loose paint or coating by brush-off blast cleaning to SSPC-SP7.
 - .6 Previously Finished Surfaces:
 - .1 Clean existing surfaces to be repainted to provide bond. Remove rust, scale, oil, grease, mildew, chemicals and other foreign matter. Remove loose paint and fill flush with suitable patching material.
 - .2 Clean off bubbled, cracked, peeling or otherwise defective paint by stripping with suitable environmental strippers.
 - .3 Treat residue from stripping as Hazardous Waste. Flatten gloss paint and varnish with sandpaper and wipe off dust.
 - .4 If previous coatings have failed so as to affect proper performance or appearance of coatings to be applied, remove previous coatings completely and prepare substrates properly and refinish as specified for new work.
 - .5 Leave entire surface suitable to receive designated finishes and in accordance with finish manufacturer's instructions.
 - .7 Gypsum Board:
 - .1 Examine and ensure gypsum board surfaces are without defects or deficiencies and suitable to receive painting applications. Commencement implies acceptance of gypsum board work. Examine surfaces for imperfections showing through and fill small nicks or holes with patching compound and sand smooth.
 - .2 Clean surfaces dry, free of dust, dirt, powdery residue, grease, oil, wax or any other contaminants. Sand and dust as necessary prior to painting. Examine surfaces after priming for imperfections showing through.
 - .3 Ensure glass mat reinforced gypsum is prepared to receive high solid primer with minimum 40% volume solids. Ensure primer is applied with recommended roller to achieve film thickness in one coat or two coats.

3.03 APPLICATION

- .1 Paint interior and exterior exposed elements as noted on Room Finish Schedule and as required to complete design requirements. Do not paint excluded components indicated herein. Where an item or surface is not specifically mentioned in Schedules, Provide same finish as similar adjacent materials or surfaces. If color or finish is not designated, Consultant will select from standard colors or finishes available.

- .2 Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.
- .3 Apply materials in accordance with manufacturer's directions and *Specifications* paying particular attention to appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint *Specifications* require earlier applications. Apply subsequent coatings in accordance with manufacturer's recommended recoat "windows". Do not use adulterants. Do any reduction of coating's viscosity in accordance with manufacturer's directions.
- .4 Use up paints within the period of shelf life recommended by paint manufacturer.
- .5 Successive coatings to be harmonious chemical compositions and materials of same manufacturer.
- .6 Thoroughly mix materials before application. Apply materials evenly, under adequate illumination, free from sags, runs and other defects. Do cutting-in neatly and ensure paint is applied wet edge to wet edge.
- .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 Ensure each coat is dry and hard as per manufacturers' recommendations for recoats before a following coat is applied.
- .9 Continue through paint finish behind wall-mounted items (e.g. marker boards and tack boards).
- .10 Finishes and number of coats specified hereinafter in Paint Finishes Schedule are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimum coverage and appearance. Some materials and colours may require additional coats and deeper colours may require use of manufacturers' special tinted primers.
- .11 Apply additional paint coats, beyond number of coats specified for any surface, to completely cover and hide substrate and to produce a solid, uniform appearance.
- .12 Allow each coat of paint to cure and become dry and hard before application of succeeding coats (unless manufacturer's directions require otherwise).
- .13 Before finishing paint coats are applied, inspect and touch-up shop coats of primers previously applied by other trades or fabricators.
- .14 Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas which have been cut and patched. Patched appearance is not acceptable.
- .15 Finish paint factory primed surfaces. Do not paint baked paint surface, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory.
- .16 Sand smooth paint and varnish undercoats prior to recoating.
- .17 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.
- .18 Ferrous Metal Surfaces: Apply primer coat to unprimed ferrous metal surfaces.

3.04 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Prime and paint exposed, electrical raceways, fittings, outlet boxes, exposed junction boxes, pull boxes, conduit, pipe, ductwork and similar items.
- .2 Keep sprinkler heads free of paint.
- .3 Take steps to protect gauges, identification plates and similar items from being painted over or paint splattered.
- .4 Remove grilles, covers, access panels for mechanical and electrical systems from installed location and paint separately, if these items are not factory finished.
- .5 Paint work to match surfaces they are seen against unless directed otherwise.

3.05 CLEANING

- .1 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- .2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.
- .3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements

of authorities having jurisdiction.

- .4 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, etcetera), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

3.06 INTERIOR PAINT AND COATING SYSTEMS:

- .1 Paint interior surfaces in accordance with the following MPI Painting Manual requirements:
 - .1 **Aluminum, unanodized:** Premium Grade (3-coat) finish.
 - .1 INT 5.4J Alkyd, satin finish (over quick dry primer for aluminum).
 - .2 **Plaster and Gypsum Board:**(Drywall); Premium Grade (3-coat) finish.
 - .1 INT 9.2A Latex finish (over latex sealer), eggshell on walls, flat on ceiling.
 - .3 Metal Fabrications: Premium Grade (3-coat) finish.
 - .1 INT 5.3K Water based light industrial satin coating (over water based primer).
 - .4 **Concrete vertical surfaces:** (including ceilings)
 - .1 INT 3.1C High performance architectural latex; gloss level G3.
 - .5 **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 5.1R High performance architectural latex; gloss level G5.
 - .6 **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.
 - .3 Wet and service areas; walls and ceilings: G5.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

- .1 Section includes:
 - .1 Wall protection.

1.02 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets: Submit manufacturer's current printed product literature, specifications, installation instructions, and field reports use in the work of this section.
- .3 Samples: Submit duplicate sample pieces, 200 mm (12") square, in specified finish.
- .4 Quality Assurance Submittals: Submit the following:
 - .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.
 - .3 Manufacturer's Field Reports: Specified herein.
- .5 Closeout Submittals: Submit the following:
 - .1 Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - .2 Warranty: 20 years from date of substantial completion.

1.03 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. Leave protective film on panel until ready to use.

1.04 FIELD CONDITIONS

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18°C and 24°C for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C 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 Do not expose wall protection to direct sunlight during or after installation.

1.05 WARRANTY

- .1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- .2 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
- .3 Warranty Period shall be 20 years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- .1 Manufacturer: Altro Canada Inc
 - .1 6221 Kennedy Road, Unit 1 Mississauga ON L5T 2S8
Representative: Chris Johnson CJohnson@altro.com 1-800-565-4658

2.02 HYGIENIC WALL COVERINGS

- .1 Acceptable material: Altro Whiterock:
 - .1 Thickness: 2.5 mm; Panel Width: 1220mm (4'-0") Panel Height: 2500mm (8'2"); cut to dimensions indicated on Drawings
- .2 Colour: Colour to be selected from manufacturer's current range

2.03 ACCESSORIES

- .1 Including but not limited to:
- .2 Vinyl welding rod: Acceptable material:
 - .1 Altro weld rod – Colour to match panel
- .3 Joint Strips: 2-Part Joint Strip (8' or 10') – to match panel color
- .4 Start and Edge Trim: 2-Part Start and Edge Trim – colour to match panel, Length as indicated on Drawings.
- .5 Acrylic Adhesive: For porous, even substrates (and climate-controlled areas) use Altro W157, one-part, water-based, acrylic adhesive as recommended by manufacturer.
- .6 Polyurethane Adhesive: For wet, non-porous substrate (and areas subject to temperature fluctuations) use Altro W39 2-Part Adhesive
- .7 Sanitary Sealant Compounds and Tape Adhesion Promoter:
 - .1 Altro Sanitary Sealant – [A802 White, A803 Clear, A806/** color] 10.5 oz Tube
 - .2 Ecofix 75 Spray Adhesive
- .8 Double-Sided Tape: 50mm (2") Double-Sided Tape A815/216 – 33 lm roll.

2.04 SOURCE QUALITY

- .1 Source Quality: Obtain Wall products from a single manufacturer.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog, installation instructions and product label instructions for installation.

3.02 EXAMINATION

- .1 Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.03 SUBSTRATE PREPARATION

- .1 Prepare walls to be smooth and level. Remove high points and fill low points with filler intended for the substrate and environmental conditions.
- .2 Ensure surfaces are permanently dry and free from all substances that may contribute to adhesive bond failure.

- .3 Remove loose paint and conduct an adhesive bond test with paint.
- .4 Ensure Drywall substrates are paint ready.

3.04 PREPARATION

- .1 All surfaces must be free from dust and cleaned prior to Altro Whiterock installation. The working environment must also be dust free. Failure to comply with these conditions will reduce the bond strength between the adhesive and substrate and may cause the Altro Whiterock panels to debond.
- .2 Very absorbent / porous substrates (particularly plaster finishes and unprimed sheetrock) must have a proprietary sealer e.g. PVA primer or similar, applied to the surface a minimum of 12 hours prior to the installation.
- .3 All electrical switches, power points etc., should be in a first fix / installation state.
- .4 All plumbing should have pipe-work removed to a first fix or installation state and "tails" left protruding from the substrate. Altro Whiterock panels can then be drilled and slid over the pipe tails. All holes should be drilled 1/8" (3mm) oversize to allow for expansion, then sealed with Altro Sanitary Sealant.
- .5 All pipes, fixing bolts, etc. extending through the Altro Whiterock panels should have a minimum 1/8" (3mm) expansion gap and be sealed using Altro Sanitary Sealant.
- .6 Ensure doorframes are in place prior to installation of wall panel.
- .7 Prior to installation, complete any painting which comes in contact with wall panel. Sealant used at junctions is non-paintable.
- .8 Store panels flat and pre-condition a minimum of 72 hours in ambient temperatures similar to prevailing operational conditions.
- .9 Store the panels on a level flat surface off the ground. Do not store on uneven surfaces.
- .10 Check the room using a 6' (2 m) level to ensure all walls are flat, paying particular attention to the corners, window reveals, and door entrances. These need to be inspected to ensure they are free of any debris or irregularities, which could prevent the panels laying flat to the substrate after the adhesive has been applied and the panel installed.

3.05 INSTALLATION

- .1 Hygienic Wall Installation: Install Altro Whiterock in accordance with the current Altro Whiterock Installation Guide. All joints should be joined by approved methods as detailed in the installation guide. Failure to install Altro Whiterock in accordance with recommended procedures will void the Altro Limited Product Warranty.

3.06 FIELD QUALITY REQUIREMENTS

- .1 Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.07 CLEANING

- .1 Once all panels and joints are installed, remove protective film and clean all surfaces down with antistatic solution or antistatic wipes. This is required as the panel may have static build up and any dust in the atmosphere will adhere to the surface of the panel.
- .2 Clean wall panel with a diluted soap/detergent solution as required. Temperature of water shall not exceed 140° F (60° C).
- .3 To reduce the buildup of static, cleaning the panels with an anti-static solution is recommended.
- .4 For stubborn stains use AltroClean 44 cleaner or equivalent alkaline cleaner, please refer to current maintenance guidelines for this product.

3.08 PROTECTION

- .1 Do not install near open heat sources (ovens, etc).

END OF SECTION

PART 1 GENERAL

1.01 GENERAL INSTRUCTIONS

- .1 Read and conform to Division 1 requirements and documents referred to therein.

1.02 SUMMARY

- .1 Work Included: Provide miscellaneous specialties including but not limited to following:
 - .1 Coat Hooks (CH1, CH2)
 - .2 Soap Dispenser (SD)
 - .3 Paper Towel Dispenser (PTD)
 - .4 Emergency Shower Curtain and Track (ESC)

1.03 REFERENCES

- .1 Definitions:
 - .1 Installation:
 - .1 This includes coordination with other Sections, labour, material and equipment necessary for off-loading of equipment, handling, storing and dismantling of parts if required.
 - .2 Make provisions for transferring items to proper location in building, connections to building services, covering and protecting, final removal of covering and protection and making ready as required to form fully operative equipment.
 - .3 Install items with security fasteners and security anchoring devices in security areas.
 - .2 Purchase: This includes labour, materials and equipment necessary for purchase and delivery of equipment to site.
- .2 Reference Standards:
 - .1 Latest published edition of reference standards listed herein are applicable to this Project unless otherwise indicated.
 - .2 Reference amendments adopted prior to the effective date of this Project are applicable unless otherwise indicated.

1.04 SUBMITTALS

- .1 Product Data: Submit manufacturer's Product data sheets, include product characteristics, performance criteria, physical size, finish, limitations and installation instructions for each material and Product used.
- .2 Shop Drawings: Submit Shop Drawings indicating material characteristics, details of construction, connections and relationship with adjacent construction.
- .3 Samples for Verification: provide samples of shower curtain fabric in 200 mm square or larger as required to show complete pattern, with specified treatment applied.
- .4 Maintenance Instructions: Submit maintenance instructions in accordance with Section 01 70 00.

1.05 QUALITY ASSURANCE

- .1 Qualifications: Provide Work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- .2 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.

PART 2 - PRODUCTS

- .1 PRODUCTS

- .1 COAT HOOKS (CH1, CH2)
 - .1 Coat Hooks (CH): Supply satin-finish stainless steel hooks, single hook type supplied with screws. Provide the hook type as, installed on plywood back boards where shown, in the quantities shown on the drawing.
 - .2 Model No.: As indicated on drawings. No substitutions permitted.
- .2 SOAP DISPENSER (SD): Provide soap dispenser as indicated on the drawings.
 - .1 Model No.: As indicated on drawings. No substitutions permitted.
- .3 PAPER TOWEL DISPENSER (PTD): Provide paper towel dispenser as indicated on the drawings.
 - .1 Model no: As indicated on drawings. No substitutions permitted.
- .4 EMERGENCY SHOWER CURTAIN (ESC): Provide shower curtain and track as indicated on the drawings.
 - .1 Track and Hooks: As indicated on drawings.
 - .2 Curtain: Traditional Non-Vinyl manufactured by Construction Specialties, fire retardant and antimicrobial.
 - .1 Pattern: Shower Sheild
 - .2 Colour: Snow.
 - .3 Size: length: 2000 mm, width 800 mm.
 - .4 Grommets fabricated from rustproof nickel-plated brass and spaced not more than 100 mm on centre.
 - .5 Provide two curtains at each emergency shower indicated.
 - .6 Fire resistance: tested to NFPA 701.

.2 FABRICATION

- .1 Fabricate finished work free from distortion, weld splatter and defects detrimental to appearance and performance.
- .2 Provide exposed metal fastenings and accessories of the same material, texture, colour and finish as the base metal to which they are applied or fastened, unless otherwise specified.
- .3 Do not expose trademarks or labels on finished surfaces.

PART 3 - EXECUTION

.1 INSTALLATION

- .1 Install coats hooks in quantity indicated installed on plywood back boards as shown on the drawings.
- .2 Install paper towel and soap dispensers on wall.
- .3 Installed curtain track affixed to emergency shower piping as per manufacturer's requirements. Install shower curtain on metal hooks.
- .4 Conform to manufacturer's printed instructions for accurate, secure installation. Ensure proper operation.
- .5 Provide work of this Section true to dimensions, square, plumb, level and free from distortion or defects detrimental to appearance and performance.

.2 PROTECTION

- .1 Cover finished surfaces and protect exposed corners and areas vulnerable to damage by persons or by movement of materials, tools or 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 01 - 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 is "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", Engineer.

- .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 Engineer they made all reasonable efforts to procure the specified product or material in a timely fashion,
 - .2 the manufacturer must advise the Engineer 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 Engineer at no additional costs to the contract,
 - .4 the Engineer 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.

1.11 Owner's Special Requirements for existing sites

- .1 Under no circumstances are any electrical or mechanical systems to be disabled or activated without prior knowledge and approval by the Owner's Project Manager. Prior to disabling or activation of any electrical or mechanical systems, Building Operations and Building Security must also provide approval.
- .2 Schedule work and meet the sub-trades daily on site, showing all trades people the work areas and work to be done.

- .3 Trades-people are to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned by the Owner.
- .4 Contractor is responsible for all associated environmental cleaning to the job site, daily during construction and upon completion. This includes both under raised floor and above ceiling. No materials or garbage will be permitted to be stored on the loading dock.
- .5 Special care and attention must be adhered to at all times when transporting equipment and materials to prevent accidental damage to the fire protection equipment and all furnishings and fixtures.
- .6 For any fire system isolation requests, allow for 24 hours notification to Building Operations.
- .7 For any open flame work, a fire extinguisher and security fire watch is required, and will be provided and paid for by Owner. Provide 24 hour notice prior to work to allow Owner to make necessary arrangements.
- .8 Storage of materials on site must be cleared through the Building Manager.
- .9 Contractors must perform a daily cleanup prior to leaving the site.
- .10 Oxygen and acetylene cylinders are to be secured at all times and capped nightly.
- .11 Work performed on operating and redundant systems must be restored to their normal condition at the end of each work day unless otherwise approved by the Owner.

2 SUBMITTALS

2.1 Requests for Information (RFIs)

- .1 Submit requests for information (RFIs) in accordance with Division 01 specification:
 - .1 Submit to the Prime Consultant for distribution and tracking with the design team;
 - .2 Include relevant and applicable Drawing and/or Specification reference for the RFI;
 - .3 Provide photos, hand sketches or other material to support and clarify the intent of the RFI.
- .2 If submitting the RFI directly to Loring Consulting Engineers for review and comment, the RFI shall be submitted with all necessary information by email to: rfi.toronto@loringengineers.com

2.2 Shop Drawings and Product Data Sheets

- .1 Submit shop drawings, manufacturers and product data and samples in accordance with Division 01.
 - .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 by email to: ca.toronto@loringengineers.com
- .2 Include a Loring Consulting Engineers, Inc. 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) Loring 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 Loring 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;
- .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.

2.3 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.

2.4 Change Order Quotation Review

- .1 Submit change order quotations in accordance with general conditions and as specified herein:
 - .1 Submit to the Prime Consultant for distribution and tracking with the design team;
- .2 If submitting the quotation directly to Loring Consulting Engineers for review and comment, the quotation shall be submitted with all necessary information by email to: ca.toronto@loringengineers.com

2.5 Progress Draw Certification

- .1 For all trades applicable to the Division 20 scope of work (inclusive of Division 21, 22, 23 and 25), the Contractor is to submit to the Prime Consultant for distribution and tracking with the design team for review and recommendation;
 - .1 Include relevant invoice breakdowns that show itemized contract value, percent complete to date, and percent complete applicable to the current invoice;
 - .2 Itemize all approved Change Orders in similar fashion separate from the Base Bid breakdown.
- .2 If submitting the progress draw directly to Loring Consulting Engineers for review and comment, the progress draw shall be submitted with all necessary information by email to: ca.toronto@loringengineers.com

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 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 Engineer. 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

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 Engineer'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.
 - .1 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan of reinforcing rods, such as Hilti PS200 Ferroscan, and review with Structural Engineer. Based on these results, arrange and pay for supplemental x-ray examination to locate concrete reinforcement and embedments where required. Submit x-rays and obtain approval before starting work Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling.

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. Route pipes, ducts, conduits and other services to avoid interference with existing installation.
- .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 MOVING AND SETTING IN PLACE OF OWNER'S EQUIPMENT

9.1 S.B.O. (Supplied by Owner)

- .1 Items marked SBO on drawings will be;
 - .1 purchased by Owner.
 - .2 received, checked, and stored and
 - .3 subsequently unpacked, uncrated, assembled and located by Contractor under Division 1
- .2 Connect mechanical and electrical services to this equipment.

9.2 E.R. or Ex. Rel. (Existing Relocated) or otherwise so identified

- .1 Items so marked on drawings will be;
 - .1 moved from their present location and reinstalled by Contractor under Division 1.

- .2 Disconnect and reconnect mechanical and electrical services to accommodate this equipment relocation.

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 Section 01 78 39 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 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 All Price catalogue or Mechanical 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) 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.
 - (b) The all-inclusive hourly journeyman labour rate applicable for quotations submitted for changes to the work is 2.9 times the base Schedule of Wage Rates issued by the Government of Canada for the Ontario – Toronto Zone. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 3.5 times Schedule of Wage Rates issued by the Government of Canada for the Ontario – Toronto Zone.
 - (c) The all-inclusive hourly labour rate indicated above is to include:
 - Collective Agreement relevant to the place of work (vacation pay, parking fees, 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.
 - (d) Foreman Mechanical rates shall be as for the calculated Journeyman rate above plus 10% of the Journeyman rate. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.
 - (e) No other overhead supervision hours will be permitted.
 - .2 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) The Contractor is allowed a combined overhead and profit fee of 15% for work to be performed by his own forces.
 - (c) The Contractor is allowed an overhead and profit fee of 10% for work performed by a Sub-Contractor

17 CONSULTANT REVIEWS

17.1 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.

17.2 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.

17.3 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.

17.4 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.

17.5 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.

18 CORRECTION AFTER COMPLETION

18.1 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.

19 ATTACHEMENTS

19.1 Shop Drawing Submittal Form

- .1 Attached sample of shop drawings submittal form.



SHOP DRAWING SUBMITTAL

*Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.
Submit one submittal form per shop drawing; do not group under one submittal sheet*

Client/Architect: [Client/Architect name]
Project Name: [Project name]
Loring Project No: [Loring Project No]

Contractor to complete the following for each submission.

Date: _____
Contractor Name: _____ Ref No: _____
Manufacturer Name: _____
Product Type: _____
Specification Section No: _____

Contractor Trade:

<input type="checkbox"/> HVAC	<input type="checkbox"/> Plumbing	<input type="checkbox"/> Fire Protection	<input type="checkbox"/> Controls
<input type="checkbox"/> Electrical	<input type="checkbox"/> Communications	<input type="checkbox"/> Security	<input type="checkbox"/> General Trades

If this is a resubmission, check here:
Previous submission Loring reference no.: _____

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

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*

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 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

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
 - .3 600 mm x 600 mm (24 in x 24 in) for personnel entry,
 - .4 300 mm x 450 mm (12 in x 18 in) for hand entry, and
 - .5 constructed of stainless steel in areas finished with tile or marble surfaces
 - .6 constructed of stainless steel with neoprene gasketed door in damp and high humidity areas
 - .7 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 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 2 straight pattern bronze with hose end male thread, cap and chain.

4 SLEEVES

4.1 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.

4.2 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 ($\frac{1}{2}$ in) all round, and
 - .2 sized to clear conduits, bare pipes, and bare ducts by 6 mm ($\frac{1}{4}$ in) all round.
- .3 Sleeves for pipes, conduits and ducts smaller than 0.4 m² (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 m² (4 sq ft) through gypsum board partitions:
 - (a) 1 mm (20 ga) minimum sheet metal, lapped and spot welded with 20 mm ($\frac{3}{4}$ in) lip flange at one end.
- .4 Sleeves for ducts 0.4 m² (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 ($\frac{3}{4}$ in) lip flange at one end.

4.3 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 m² (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 m² (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.

4.4 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.

5 FIRE STOPPING AND SMOKE SEALS

5.1 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.

5.2 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.

5.3 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.

6 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.

6.2 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.

7 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.

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 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

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, or
- (b) Ball

.2 for flow balancing and shut-off service valves to be

- (a) Double regulating and
 - to incorporate adjustable limit stops.

.2 On mains and risers, drain valves to be selected as follows

.1 On mains NPS 4 and under

- (a) NPS $\frac{3}{4}$ brass threaded ball valve of appropriate pressure rating with hose thread, cap and chain.

2.2 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
- .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
 - Crane 7TF
 - Jenkins 106BJ
 - Newman Hattersley 13
 - Nibco T-235-Y
- .5 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
 - Jenkins 4093J
 - Newman Hattersley 47 with NPT copper adaptors
 - Nibco S-413
- .6 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

.7 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)

.8 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

2.3 Heating and cooling water valves

.1 Gate valves NPS 2 and under, soldered

- .1 1000 kPa (150 psi) rising stem to MSS SP-80, Class 125 with bronze body, bronze wedge disc and screw in bonnet.

Standard of Acceptance

- Kitz 44
- Crane 1700-S
- Jenkins 991AJ
- Newman Hattersley #608 with NPT copper adaptor
- Nibco S-111

.2 Gate valves NPS 2 and under, threaded

- .1 1000 kPa (150 psi) rising stem to MSS SP-80-1990, Class 125, with bronze body and bronze solid wedge disc, screw in bonnet.

Standard of Acceptance

- Kitz 24

- Crane 428
- Jenkins 810J
- Newman Hattersley #608
- Nibco T-111

.3 Globe valves NPS 2 and under, soldered

- .1 1000 kPa (150 psi), Class 150 to MSS SP-80, Class 150, bronze body, renewable PTFE composition disc, threaded in bonnet and lockshield handles where shown.

Standard of Acceptance

- Kitz 10
- Crane 7
- Jenkins 106BP5
- Newman Hattersley #13 with NPT to 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 PTFE composition disc, union bonnet and lockshield handles where shown.

Standard of Acceptance

- Kitz 09
- Crane 7TF
- Jenkins 106BJ
- Newman Hattersley #13
- Nibco T-235-Y

.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 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

.8 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

.9 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. Armstrong CBV
- Tour & Anderson series 787
- Newman Hattersley #1700
- 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 Install double regulating valves with five pipe diameters of straight pipe on inlet side and two pipe diameters on outlet side.

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 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),
 - .2 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
 - .3 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 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 TSSA 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 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

- .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

2.6 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 EI 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, galvanized 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, galvanized 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 Rodding 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

2.11 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),

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)
¾ 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)

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)
¾ 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)

- .6 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.
- .7 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.
- .8 Offset hangers so that rods are vertical in operating position.
- .9 Provide hanger within 300 mm (12 in) of each horizontal elbow and tee.
- .10 Clamp and rod tees, elbows, and joints, in plain end mechanical joint pipe NPS 5 and over.
- .11 Riser clamps:

- .1 Weld lugs onto steel piping.
- .2 Solder copper pipe to copper riser clamps.

- .12 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 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.

3.5 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.

3.6 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

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 ¼ in),

- .5 engraved with 10 mm ($\frac{3}{8}$ 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 ($\frac{3}{4}$ 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 ($\frac{3}{4}$ in) nominal and smaller.
 - .5 applicable WHIMS pictogram for identification of material hazard.

2.4 Ductwork Identification

- .1 Paint stencilled letters 25mm (1 in) high showing;
 - .1 duct service,
 - .2 fan number, and
 - .3 arrows showing direction of flow,

2.5 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

- .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 - Medical Gas Systems

- .1 Provided identification markings on medical gas systems:
 - .1 maximum every 6 m (20 ft) along length of pipe,
 - .2 before and after barriers, floors and walls,
 - .3 at each valve,
 - .4 behind access doors ,
 - .5 inlet and outlet points including vents.

3.4 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.

3.5 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 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.

3.6 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) inside fire hose cabinets,
 - (b) radiation heating units, unit heaters, or fixture stops,
 - (c) 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:

<p>Domestic Cold Water #12 Riser C-1 Service Valve - B2</p>
--

- (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:

<p>Reheat Supply #57 Room 2-254 Balancing Valve - CBV 3/4</p>
--

- (c) automatic control valve used for pressure balancing the system, with an equipment schedule ID of CV-15, and is globe style NPS 3:

<p>Constant Pressure Differential Valve CV-15 Automatic Control Valve - GL 3</p>

- .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.

3.7 Pipe and Valve Identification Classification

- .1 Use existing coding system for building additions and alterations.

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.

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.

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.
- .2 Adhesive for flexible closed cell foam insulation:
 - .1 Volatile Organic Content: maximum 80 g/L.
- .3 Lap seal adhesive:
 - .1 for joints and lap sealing of vapour barriers.
 - .2 Volatile Organic Content: maximum 250 g/L.
- .4 Fibrous insulation adhesive:
 - .1 Volatile Organic Content: maximum 250 g/L

Standard of Acceptance

- Bakor - No. 220-05
- Foster – Drion 85-75

Standard of Acceptance

- Armaflex 520 BLV
- Armaflex Low VOC Spray Contact Adhesive
-

Standard of Acceptance

- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

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 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
-

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 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 straight pipe, duct or plenum:

- (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

2.5 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 Ecosse (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: -73°C to +121°C (-100°F to 250°F).
- .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/C @ 24°C (0.13 btu/hr/in/sq ft/F @ 75°F),

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 Tecton 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: -73°C to +121°C (-100°F to 250°F).
- .5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,
- .6 density: 120 kg/m³ (7.5 lb/ft³)

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 Insulate condensate drain piping to the same criteria as its associated cooling system.
- .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 Insulate accessories for Hot Piping systems with design temperatures greater than 93°C (200°F):
 - .1 with type P-9 removable fitted insulation covers,
 - .2 allow free movement of valve actuator.
- .3 No insulation is required on pipeline accessories for Hot Piping systems with design temperatures of 93°C (200°F) or less.
- .4 Insulate accessories for Cold and Dual Temperature Piping systems for chilled water and liquid refrigerant piping:
 - .1 lined with two layers of 25 mm (1 in) P3 elastomeric blanket or one layer of 25 mm (1 in) thick P-4 phenolic insulation, with no voids at corners or joints,
 - .2 at locations requiring access, extend insulation to create collar around bolted connection, and install a compression fit piece of insulation to cover equipment.

- .5 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 Painted Piping

- .1 Not applicable.

3.14 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.

3.15 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)				
		P-4	20 (¾)	20 (¾)	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 (¾)	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 (¾)	20 (¾)	20 (¾)	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)

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)				
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	PVC
	Indoors - painted pipe	All	Fabric

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.
- .3 Rechecking of testing and balancing during the alternate (heating/cooling) season.

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
 - .7 Alternate Season test 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 M\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) Sprinkler systems (to NFPA 13)
 - (e) Standpipe systems (to NFPA 14)
- .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) domestic hot water heaters,
 - (b) adjustable frequency drives,
 - (c) 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.

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 10% 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.

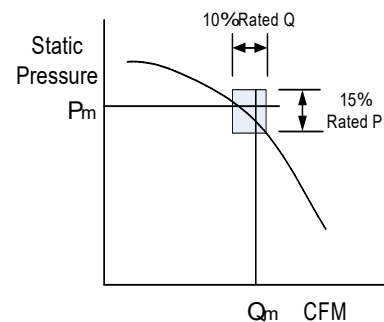
- .3 Air quantities at each exhaust system inlet and supply system outlet are to be measured and throw and pattern is to be adjusted at each supply outlet.
- .4 Balancing to be provided to all air outlets and inlets to airflow rates as indicated on plans.

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.

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 Heat Transfer Equipment:
 - .1 manufacturer and type,
 - .2 inlet and outlet temperatures,
 - .3 pressure drop,
 - .4 flow rate.

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 10% 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.
- .2 Submit all supporting close-out documents by email to ca.toronto@loringengineers.com for review by Consultant.

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.
- Sprinkler installation certification report to NFPA 13.
- Standpipe installation certification report to NFPA 14..
- Air and Water Balancing reports (Interim).
- 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:	<input type="checkbox"/> Reviewed <input type="checkbox"/> 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:	<input type="checkbox"/> Reviewed <input type="checkbox"/> 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 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.

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 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.
- .8 No zinc plated galvanized steel shall be used in LAN rooms. Use hot dipped galvanized instead.

3.2 Existing Conditions

- .1 Contractor shall verify in the field the existing conditions before proceeding with work.
- .2 Contractor shall coordinate the work with 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.
- .5 Contractor & its sub's shall be responsible for locating all existing sprinklers and related piping as well as removing sprinklers as required to meet new proposed sprinkler head layout.

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.

3.4 Removal

- .1 Verify all governing dimensions, pipe sizes and location of the piping and equipment to be removed.
- .2 Notify Owner at least 48 hours before demolition work or before shut down of existing services. Riser shut downs shall be performed at contractor's cost, at designated times under Building Management supervision and only with approval.
- .3 The contractor's work activities shall not interfere with the building services in any way without the express permission in writing by the Owner. Such interruptions and interferences shall be made as brief as possible and only at the time stated by the Owner.
- .4 Upon completion of removal work, no abandoned piping shall remain.
- .5 No removed existing piping fittings, valves, etc. shall be reused unless otherwise approved by the engineer.

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 hydraulic calculations 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 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.

1.6 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.
 - 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.

3 EXECUTION

3.1 General

- .1 Extend piping and connect to sprinklers.
- .2 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 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 Not used.

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 verify in field existing conditions before proceeding with work and coordinate the work with all trades and existing conditions.
- .6 Contractor shall coordinate slab penetrations with Owner.
- .7 Cut, patch and paint ceilings and slab as required to meet existing conditions.

3.2 Domestic cold water system distribution

- .1 Extend existing domestic cold water system with
 - .1 distribution pipe and fittings,
 - .2 valves,
 - .3 premises backflow isolation,
 - .4 zone or equipment backflow protection.

3.3 Domestic hot water system distribution

- .1 Extend existing 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 Extend existing 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 waste and vent connections to plumbing fixtures and equipment.
- .2 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.

3.7 Flushing and Disinfecting - Water Service Pipe

- .1 Complete piping pressure tests prior to flushing and disinfecting operations. Notify Consultant at least two days in advance of date when disinfecting operations are proposed, so that the Consultant may witness the tests.
- .2 Isolate the water service pipe inside the building at the point of entry, from the building water distribution system. Flush water service pipes for a minimum of 10 minutes to produce a water velocity of 1.5 m/s (5 fps) and discharge water to drain or other acceptable area.
 - .1 Minimum flushing flow rates:

Pipe size	Minimum Flow	
	L/s	usgpm
NPS		
2	3.3	52
2 1/2	4.7	75
3	7.3	115
4	12.6	200
6	23.4	450
8	49	780
10	76	1200
12	110	1750

3.8 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	
	L/s	usgpm
NPS		
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

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 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"

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 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 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.

.3 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.

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.
- .5 Floor mounted water closets fitted with china bolt caps.
- .6 Where fixtures and trim are identified by manufacturers' catalogue designation these references are to establish quality standards. For the purposes of this section of the specification, fixtures or trim from manufacturers listed below are equally acceptable when conforming to the same level of quality.

Standard of Acceptance

- American Standard
- Crane
- Kohler
- Delta Commercial
- Beneke
- Centoco
- Kindred

2 PRODUCTS

2.1 Hand Hygiene Sink "S-1"

- .1 American Standard ICU Basin #9118.111.020 - Center hole only, 509 mm x 432 mm x 663 mm (20-1/16" x 17" x 26-1/8") high, Rectangular, Vitreous china with EverClean antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew, White Finish, 65 mm (2-9/16") dia. Faucet perch, back of sink 93 mm (3-11/16") higher than faucet perch, Offset grid drain included, integrated mounting brackets, P-trap with Saniguard coating provided.
- .2 American Standards Electronic I.C. #605B.193.002 - Electronic Faucet, Polished Chrome finish, Center hole only, Vandal resistant brass construction, 1.5 GPM (5.7 LPM) pressure compensating laminar flow device in spout base with plain spout end, Rigid gooseneck spout, 127 mm (5") projection reach, Self-adjusting sensor, AC Powered (Hard Wired).
- .3 American Standard #PK00.HAC - Hardwired Ac - Power Kit, Includes 10' long extension cable. Lawler #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10 mm (3/8") inlets and outlet FNPT connections, Integral checks, offer temperature range between 35 °C (95 °F) and 46 °C (114.8 °F). Set valve temperature at 46 °C (114.8 °F). Provide tee, adaptors, and flex. copper tubing to suit installation.
- .4 McGuire #LFH170BV - Faucet Supplies, Chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, Escutcheon and flexible copper risers.
- .5 Watts #CA-311 - Fixture Carrier, mounted on concrete floor, steel hanger plate, heavy gauge epoxy coated steel offset uprights with welded feet supports. For one unit: 102 mm (4") for two to six units in a row: 152 mm (6") finished metal stud wall to back of pipe space.

2.2 Emergency Shower "ES-1"

- .1 Speakman SE-238-SR – Brass, 8" shower head with extended supply pipe. 20 GPM internal regulator, 1" NPT female brass, chrome plated, stay-open valve, 18 gauge type 304 stainless steel cabinet, 1" IPS chrome plated brass piping, wall mounted stainless steel lever with black plastic rotation handle, compliant with ANSE Z358.1
- .2 , 25 mm NPT female outlet connection, 50 gpm max flow, cold water by-pass, positive shutoff, low internal pressure drop, complete with recessed wall box. Provide shut-offs at emergency mixing valve.

2.3 Eyewash Station "EW-1"

- .1 WaterSaver #EW1022BP - Dual purpose eyewash/drench hose for deck mounting. Unit meets the provisions of ANSI Z358.1-2014. Unit to be provided with 8' reinforced PVC hose, deck flange, under counter hose guide bracket, and backflow preventor.
- .2 Lawler #911E/F - Emergency Thermostatic Mixing Valve for Eyewash or Eye/Face Wash, lead-free brass and stainless steel design, vandal-resistant temperature adjustment, stainless steel sliding piston control device allow cold flow through both the fixed and variable bypass, 13 mm (1/2") N.P.T. Outlet, positive hot water shut-off, liquid-filled thermostatic motor control mechanism, 29 °C (84.2 °F) factory set temperature, standard 69.8 °F (21 °C) - 89.6 °F (32 °C) temperature range, 26 LPM (6.9 GPM) flow capacity at 30 psi (207 kPa) pressure drop across the valve, 7.57 LPM (2.0 GPM) min. Flow rate, 18 LPM (4.8 GPM) bypass flowrate at 30 psid. (See 911E/F) Provide shut-offs at emergency mixing valve.

2.4 Floor Drain "FD"

- .1 75 mm (3") Floor drain with 100 mm (4") rim.

Standard of Acceptance

- ZURN zn415-b
- MIFAB
- watts

- .2 NPS 1½ chrome plated brass "P" trap with cleanout, brass nuts and deep escutcheon

Standard of Acceptance

- Zurn Z8702-PC

2.5 Sealant between fixture and wall finish:

- .1 One part acetoxy silicone sealant
- .2 White or clear colour
- .3 Formulated with fungicide

Standard of Acceptance

- Tremco Tremsil 200
- Dow Corning
- GE

3 EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 Hot Water Temperature Limits

- .1 Test, adjust and set temperature control on thermostatic mixing valves to supply a maximum water temperature of:
 - .1 29°C (85°F) for emergency showers.
- .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

HEATING AND COOLING PIPING SYSTEMS GENERAL 23 05 01

1 GENERAL

1.1 Scope

- .1 Provide heating and cooling piping systems.

1.2 Hot water heating system

- .1 Piping design code:
 - .1 to ASME B31.9 Building Service Piping
- .2 System includes:
 - .1 Heating coils,
 - .2 Controls.

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 Pipe 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 expansion and contraction.
- .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 expansion forces, 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.

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 (¼ 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 Terminals devices

- .1 Locate and install terminal boxes, registers, diffusers, and grilles

3.3 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 Duct Fitting Data Base.(DFDB) ASHRAE
 - .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, High Strength and Ultra-
 - .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

1.3 Shop Drawings and Application Details

- .1 Submit manufacturer's catalogue literature for;
 - .1 Proprietary joints,
 - .2 Hardware.

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) Z180 (G60) for indoor ductwork,
 - .2 Miscellaneous pipe, angles, strips and threaded rod in contact with ductwork: galvanized with a minimum thickness equal to ASTM A653 - Z180 (G60).
- .2 Stainless steel:
 - .1 To ASTM A480, Type 304L
- .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	Supply air ductwork from discharge side of fan to inlet of terminal box or reheat coil in healthcare and laboratory facilities.	+1000 (4)		
3	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)		
4	Return/Exhaust risers in mechanical rooms and vertical service spaces (duct shafts).	-750 (3)		
5	Return and/or exhaust air ductwork on suction side of fans <u>other than</u> in mechanical rooms and vertical service spaces.	-500 (2)	C	Transverse joints and other connections
6	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
7	Supply air and return air ductwork from roof top air conditioning units, 5 tons or less	125 (½)	D	No sealing

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
	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
		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 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.

3.5 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 (1x1x ¹ / ₈)	6 (¹ / ₄)
750 to 1050 (30 to 40)	40x40x3 (1 ¹ / ₂ x1 ¹ / ₂ x ¹ / ₈)	6 (¹ / ₄)
1050 to 1500 (40 to 60)	40x40x3 (1 ¹ / ₂ x1 ¹ / ₂ x ¹ / ₈)	10 (³ / ₈)
1500 to 2400 (60 to 90)	50x50x3 (2x2x ¹ / ₈)	10 (³ / ₈)
2400 and over (90 and over)	50x50x6 (2x2x ¹ / ₄)	10 (³ / ₈)

- .4 Maximum hanger spacing: 2.4 m (8 ft) on centre.

3.6 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/m³ (4 lb/ft³) 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.

3.7 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.

3.8 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 base of each accessible duct riser,
 - .3 in front of and behind duct mounted coils,
 - .4 at activation side of fire, smoke, and combination fire/smoke dampers,
- .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)

3.9 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 x 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

Duct Type	Seal Class		
	C	B	A
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.

3.10 Duct cleaning

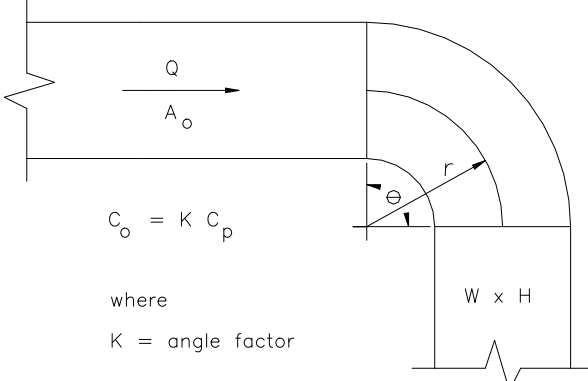
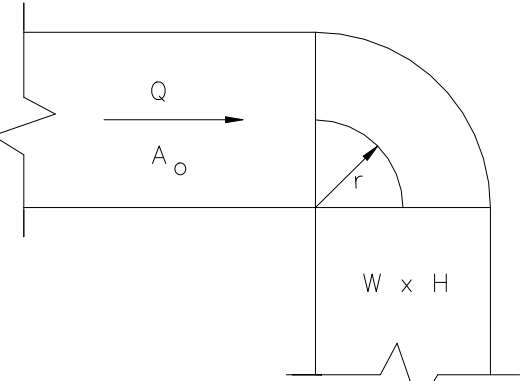
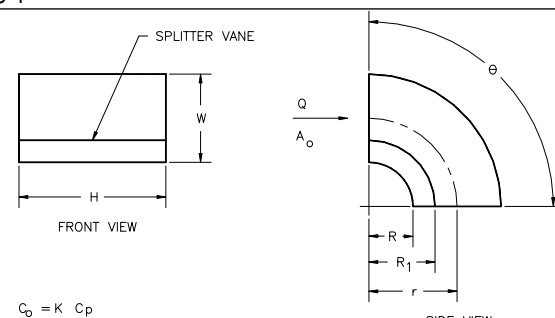
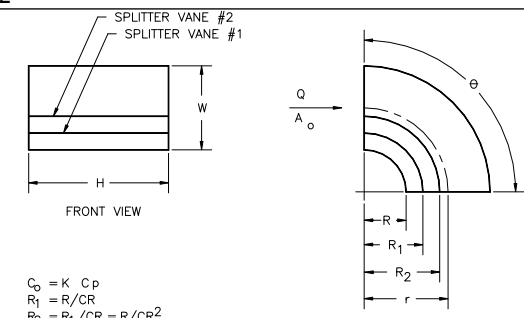
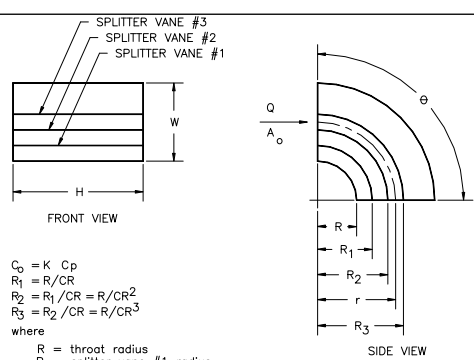
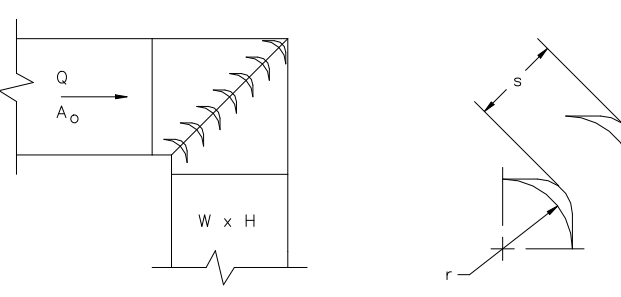
- .1 Cleaning to be performed by agent specializing in this field of work, be a member in good standing with National Air Duct Cleaners Association (NADCA), and to comply with NADCA standards.
- .2 Clean new horizontal and vertical ducts (supply, return, exhaust, transfer), as well as, existing supply 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.

3.11 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)

 <p>$C_o = K C_p$</p> <p>where $K = \text{angle factor}$</p> <p>W x H</p>	 <p>W x H</p>
<p>CR3-1</p>  <p>SPLITTER VANE</p> <p>FRONT VIEW</p> <p>SIDE VIEW</p> <p>$C_o = K C_p$ $R_1 = R/CR$</p> <p>where $R = \text{throat radius}$ $R_1 = \text{splitter vane radius}$ $CR = \text{'CURVE RATIO'}$ $K = \text{angle factor}$</p> <p>CR3-3</p>	<p>CR3-2</p>  <p>SPLITTER VANE #2 SPLITTER VANE #1</p> <p>FRONT VIEW</p> <p>SIDE VIEW</p> <p>$C_o = K C_p$ $R_1 = R/CR$ $R_2 = R_1/CR = R/CR^2$</p> <p>where $R = \text{throat radius}$ $R_1 = \text{splitter vane #1 radius}$ $R_2 = \text{splitter vane #2 radius}$ $CR = \text{'CURVE RATIO'}$ $K = \text{angle factor}$</p> <p>CR3-4</p>
<p>CR3-3</p>  <p>SPLITTER VANE #3 SPLITTER VANE #2 SPLITTER VANE #1</p> <p>FRONT VIEW</p> <p>SIDE VIEW</p> <p>$C_o = K C_p$ $R_1 = R/CR$ $R_2 = R_1/CR = R/CR^2$ $R_3 = R_2/CR = R/CR^3$</p> <p>where $R = \text{throat radius}$ $R_1 = \text{splitter vane #1 radius}$ $R_2 = \text{splitter vane #2 radius}$ $R_3 = \text{splitter vane #3 radius}$ $CR = \text{'CURVE RATIO'}$ $K = \text{angle factor}$</p> <p>CR3-5</p>	<p>CR3-4</p>  <p>W x H</p> <p>$r = 2.0 (50), s = 2.125 (60) \text{ in. (mm)}$</p>
<p>CR3-5</p>	<p>CR3-15</p>

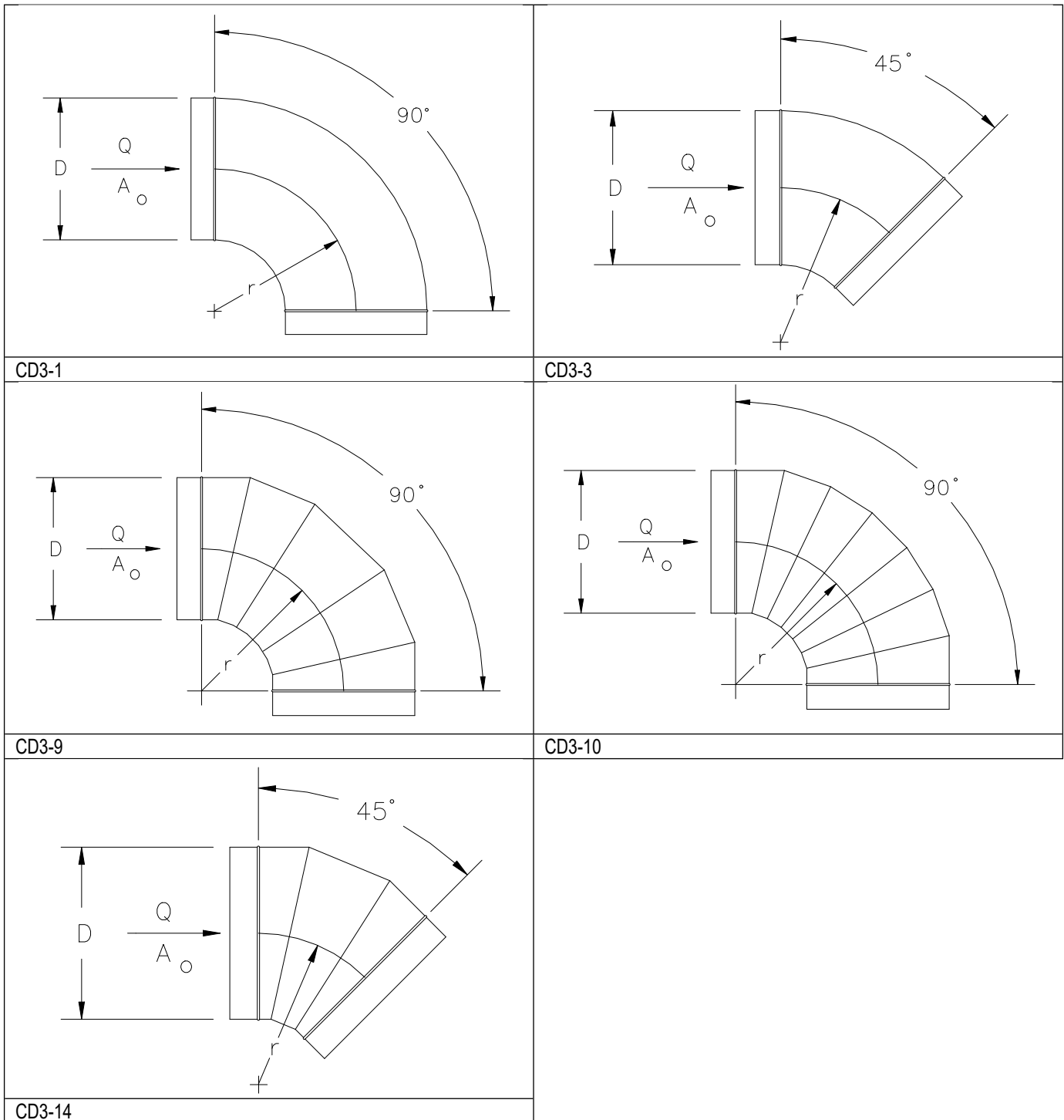
Rectangular Wyes and Tee's – Supply Ductwork (see Table 4)

<p>$A_s = A_b \geq A_c$ $r/W_b = 1.0$</p>	<p>$L = 4 \text{ in. (100mm)}$</p>
<p>SR5-1</p> <p>$L = 0.25W_b, 3 \text{ in. (75mm) min.}$</p>	<p>SR5-12</p> <p>$r/W_c = 1.5$ $Q_{b1}/Q_c = Q_{b2}/Q_c = 0.5$ $W_{b1} = W_{b2} = W_b$</p>
<p>SR5-13</p> <p>* S SLIP-ON U-CLIP OPTIONAL. ALL SUCH CONNECTIONS TO BE SEALED.</p> <p>TYPE 4A</p> <p>TYPE 4B</p> <p>SQUARE THROAT ELBOW OPTIONAL.</p> <p>VOLUME CONTROL TO BE BY OPPOSED BLADE BRANCH DAMPERS</p> <p>$W = 4" (102 \text{ mm}) \text{ MIN.}$</p> <p>$D_1 = 4" (102 \text{ mm}) \text{ MIN.}$ $D_2 = 4" (102 \text{ mm}) \text{ MIN.}$ $D_3 = 4" (102 \text{ mm}) \text{ MIN.}$</p>	<p>SR5-14</p>

Rectangular Wyes and Tee's – Return/Exhaust Ductwork (see Table 5)

<p> $A_s + A_b \geq A_c$ $r/W_b = 1$ </p>	<p> $L = 0.25 W, 3 \text{ in. (75 mm) min.}$ $A_s = A_c$ $A_b/A_c = 0.5$ </p>
<p>ER5-1</p> <p> $r/W_c = 1.5$ $Q_{b1}/Q_c = Q_{b2}/Q_c = 0.5$ $W_{b1} = W_{b2} = W_b$ </p>	<p>ER5-3</p>
<p>ER5-4</p>	

Round Elbows (see Table 6)



Round Wyes and Tees (see Table 7)

	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> $H = \frac{D_c}{2 \times \sin 45^\circ} + \frac{D_b}{2 \times \tan 45^\circ} + 4$ </div>																																				
<p>SD5-1</p>	<p>SD5-2</p> <table border="1" style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th colspan="2" style="border: none;"></th> <th colspan="2" style="border: none;">D_b</th> <th colspan="2" style="border: none;">H</th> </tr> <tr> <th style="border: none;"></th> <th style="border: none;"></th> <th style="border: none;">in.</th> <th style="border: none;">mm</th> <th style="border: none;">in.</th> <th style="border: none;">mm</th> </tr> </thead> <tbody> <tr> <td style="border: none;">3</td> <td style="border: none;">- 8</td> <td style="border: none;">75</td> <td style="border: none;">- 200</td> <td style="border: none;">4</td> <td style="border: none;">100</td> </tr> <tr> <td style="border: none;">8</td> <td style="border: none;">1/2 - 14</td> <td style="border: none;">220</td> <td style="border: none;">- 350</td> <td style="border: none;">7</td> <td style="border: none;">180</td> </tr> <tr> <td style="border: none;">14</td> <td style="border: none;">1/2 - 26</td> <td style="border: none;">370</td> <td style="border: none;">- 660</td> <td style="border: none;">10</td> <td style="border: none;">250</td> </tr> <tr> <td style="border: none;"></td> <td style="border: none;">> 26</td> <td style="border: none;">> 660</td> <td style="border: none;"></td> <td style="border: none;">13</td> <td style="border: none;">330</td> </tr> </tbody> </table>			D _b		H				in.	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
		D _b		H																																	
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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																																
<p>SD5-10</p>	<p>SD5-12</p>																																				
<p>ED5-2</p>																																					

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 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)

2.2 Tape

- .1 polyvinyl treated open weave glass fibre tape, 50mm (2") wide.

Standard of Acceptance

- ° Duro-Dyne FT-2

2.3 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

2.4 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 Sealant and tape

- .1 Apply to ductwork joints and seams as detailed in other sections.

3.2 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.

3.3 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 as 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 where branch serving more than two outlets is taken from main supply duct, use splitter damper in take-off fitting, or single or multiple blade damper in branch.
 - .2 where branch joins main return or exhaust duct use single or multiple blade damper in branch.
- .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

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.

1.3 Samples

- .1 Submit examples of each type and style of register, diffuser and grille with sample finishes when requested.

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. Price
- Titus
- Nailor
- MetalAire

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 multiple cone or perforated face type, with adjustable pattern control,
- .2 of steel or aluminum material.

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 Coordinate with the TAB contractor to recalibrate terminal units for new minimum and maximum airflows.
- .2 Reconnect terminal units to BAS after relocation.
- .3 Reconnect temperature sensors to terminal unit and BAS after relocation
- .4 Update BAS graphics to reflect as-built conditions.

1.2 Applicable standards

- .1 ANSI/ASHRAE standard 135-2004 BACnet
- .2 ANSI 709.1 Lonworks
- .3 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.

1.3 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

1.4 Manufacturers and Installers

- .1 Controls and BAS systems to be installed by existing BAS system manufacturer.

1.5 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.

1.6 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.

1.7 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.

1.8 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, network repeaters, and network wiring.
 - .3 single-line schematics and system flow diagrams showing location of control devices.
 - .4 detailed analysis of each Sequence of Operation from design documents, ready for development of actual programming code.
 - .5 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) typical terminal unit floor plan graphic that shows conditions on occupied floor
 - (b) typical equipment room floor plan graphic
 - (c) typical graphics for each system and terminal unit at least one sample graphic for each type of equipment.
 - .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.

1.9 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.

1.10 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 debug 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 Existing BAS architecture to be retained.

2.4 General functional requirements

- .1 Existing sequence of operation for terminal units to be maintained.
- .2 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.

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.

3 EXECUTION

3.1 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.

3.2 Existing equipment

- .1 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,

- .2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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 1/2 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.

3.9 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 ¼ in),
 - .6 engraved with 6.5 mm (¼ 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;

<p>W A R N I N G</p> <p>THIS EQUIPMENT IS OPERATING UNDER AUTOMATIC CONTROL AND MAY START OR STOP AT ANY TIME WITHOUT WARNING. SWITCH DISCONNECT TO "OFF" POSITION BEFORE SERVICING.</p>
--

- .10 Submit samples of labels and nameplates for review prior to installation.

3.10 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.

3.11 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.

3.12 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.

3.13 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.

3.14 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.

3.15 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

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 Division 26, as it applies to Division 27 and 28

- .1 Division 26 contains common work requirements that are applicable to the Work of Divisions 27 and 28 and apply as if written in full within Divisions 27 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 Consultant.
- .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 additional costs to the contract,
 - .4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and the Consultant'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.

1.11 Owner's Special Requirements

- .1 Contractor to provide a written list of names of employees and sub-trades employees entering the building, advising which areas they need access to at least 24 hours prior to expected time of arrival. This lead time is required to prearrange security passes.
- .2 Security Passes to be visibly worn at all times by all employees.
- .3 Trades people to strictly adhere to Building Security regulations otherwise entrance into the building will be denied.
- .4 Trades people are to enter via the entrance identified by the Owner.
- .5 Park vehicles in designated areas.
- .6 Do not block driveways.
- .7 Use only the freight elevator to transport tools and material. Freight elevator door to be shut immediately after exiting the cab.
- .8 Do not disable or activate any electrical or mechanical system without prior approval by the Owner's Project Manager. Also, prior to disabling or activation of any electrical or mechanical system, obtain approval from Building Operations and Building Security.
- .9 Submit prior notification to Building Security Staff before any construction activity commences which will result in heat, smoke, dust or fumes, such as welding, saw cutting, soldering, spray painting, which might affect sensitive fire detection and protection equipment.
- .10 Submit notifications sufficiently in advance such that the Owner will have at least 48 hours to make the necessary arrangements should Building Operations deem that work on a particular system requires a security escort. A security escort will be required for any work being done in secured areas, e.g. mechanical, electrical or communications rooms.
- .11 Provide at least 24 hours prior notification to Building Operations for any fire system isolation requests.
- .12 Schedule work and meet sub-trades daily on site, show trades people the work areas and work to be done.
- .13 Trades-people to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned.
- .14 Provide environmental cleaning of the job site daily during construction and upon completion. This includes above ceiling. Do not store materials or garbage on the loading dock.
- .15 Provide special care, attention and protection when transporting equipment and materials to prevent accidental damage to fire protection equipment, finishes, furnishings and fixtures.

- .16 "No Smoking" – this is a smoke free building, violators will be denied entry. Smoking is not allowed on the roof.
- .17 For any open flame work, a fire extinguisher and security fire watch is required, and will be provided and paid for by the Owner. Provide 24 hours prior notice to allow the Owner to make the necessary arrangements.
- .18 Obtain the approval of the Building Manager for the storage of materials on site.
- .19 Perform a daily cleanup prior to leaving the site.
- .20 Secure oxygen and acetylene cylinders at all times and capped nightly.
- .21 Restore operating and redundant systems to their normal condition at the end of each work day.
- .22 At the conclusion of each work day, the Contractor's supervisor is to advise the Building Manager on the day's activities and plans for the next day's work.

2 SUBMITTALS

2.1 Requests for Information (RFIs)

- .1 Submit requests for information (RFIs) in accordance with Division 01 specification:
 - .1 Submit to the Prime Consultant for distribution and tracking with the design team;
 - .2 Include relevant and applicable Drawing and/or Specification reference for the RFI;
 - .3 Provide photos, hand sketches or other material to support and clarify the intent of the RFI.
- .2 If submitting the RFI directly to Loring Consulting Engineers for review and comment, the RFI shall be submitted with all necessary information by email to: rfi.toronto@loringengineers.com

2.2 Shop Drawings and Product Data

- .1 Submit shop drawings, manufacturers and product data and samples in accordance with Division 01.
 - .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 by email to: ca.toronto@loringengineers.com
- .2 Include a Loring Consulting Engineers, Inc. shop drawing cover sheet form prepared for this project, for each shop drawing (sample included at the end of this section), 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) Loring 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 Loring 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.

2.3 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.

2.4 Change Order Quotation Review

- .1 Submit change order quotations in accordance with general conditions and as specified herein:
 - .1 Submit to the Prime Consultant for distribution and tracking with the design team;
- .2 If submitting the quotation directly to Loring Consulting Engineers for review and comment, the quotation shall be submitted with all necessary information by email to:
ca.toronto@loringengineers.com

2.5 Progress Draw Certification

- .1 For all trades applicable to the Division 26 scope of work (inclusive of Division 27 and 28), the Contractor is to submit to the Prime Consultant for distribution and tracking with the design team for review and recommendation;
 - .1 Include relevant invoice breakdowns that show itemized contract value, percent complete to date, and percent complete applicable to the current invoice;
 - .2 Itemize all approved Change Orders in similar fashion separate from the Base Bid breakdown.
- .2 If submitting the progress draw directly to Loring Consulting Engineers for review and comment, the progress draw shall be submitted with all necessary information by email to:
ca.toronto@loringengineers.com

3 APPLICABLE CODES AND STANDARDS

- .1 Install electrical systems in accordance with the Ontario Electrical Safety Code (OESC).
- .2 Install underground systems in accordance with the latest edition of CSA C22.3 No.7 except where specified otherwise.
- .3 Abbreviations for electrical terms: to the latest edition of CSA Z85.
- .4 Comply with CSA Certification Standards and Ontario Electrical Safety Code Bulletins in force at time of Tender submission.
- .5 Where requirements of this specification exceed those of the above mentioned standards, this specification to govern.
- .6 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.

6.3 Pre-purchased Equipment, Damage and Ownership

- .1 At time of receipt of pre-purchased or pre-tendered equipment at job site by the installing electrical contractor, the manufacturer/distributor/supplier's 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 unloading, moving and setting in place.
- .2 In the event that the equipment or cable is 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 Contractor is responsible for repairs and/or replacement to the satisfaction of the Owner.

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, cabletrays, 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 an electromagnetic scan for reinforcing rods, such as Hilti PS200 Ferrosan, and review with the Structural Engineer. Based on these results, arrange and pay for supplemental x-ray examination to located concrete reinforcements and embedments where required. Submit x-ray results and obtain approval before starting work.

- .6 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.

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 existing panelboards 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 of 12 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 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services as necessary to accommodate the Work.
- .4 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.
- .5 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.
- .6 Unless noted otherwise removed materials and equipment become the property of the Contractor and are to be taken from the site and disposed of appropriately.
- .7 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.
- .8 For devices, fixtures and equipment to be relocated, provide junctions boxes, outlet boxes, wiring, plates, supports, etc., as necessary.
- .9 Revise panelboard directories accordingly if affected by the Work.
- .10 Clean and relamp relocated luminaires and replace any faulty ballasts.
- .11 On completion of relocations, confirm that relocated devices and luminaires are in proper working order.
- .12 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.
- .13 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 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 CONSTRUCTION POWER AND TEMPORARY ELECTRICAL SERVICES

12.1 Temporary Construction Power and Lighting

- .1 To division 01.
- .2 Provide and maintain temporary lighting throughout the project. Level of illumination on floors and stairs to be not be less than 160 Lux.
- .3 Contractor and sub-contractors to provide transformers and suitable fused disconnect switches and wiring from locations as and where required and to maintain temporary services for use of lighting, tools and apparatus, in order to facilitate completion of the Work, in accordance with the electrical code and applicable local by-laws.
- .4 Notwithstanding the above, provide a portable motor-generator set for electric welding, to avoid undue disturbances on the building's electrical distribution system. Locate motor-generator to the satisfaction of Owner.
- .5 If a temporary interruption in the Owner's utilities becomes necessary, the Owner will inform the Contractor as soon as possible before any such interruption. Contractor and sub-contractors to then take such action as is necessary to accommodate said interruption in their construction schedule.

13 FINAL CLEANING

13.1 General

- .1 Do final cleaning in accordance with Division 01.
- .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, coverplates, 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 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.

14 RECORD DRAWINGS

- .1 Provide record drawings in accordance with Division 01 and as specified herein.
- .2 A set of design drawings in AutoCad 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.

14.2 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 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.

15 OPERATING AND MAINTENANCE INSTRUCTIONS

15.1 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) Power,
 - (b) Lighting,
 - (c) Low Voltage Systems,
 - (d) 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.

15.2 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 - Lighting Controls - Division 26
 - .3 Communications – Division 27
 - .4 Electronic Safety and Security – Fire Alarm – 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.

16 CARE, OPERATION AND START-UP

- .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.

17 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 systems: fire alarm system, communications,
 - .5 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.

18 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.

19 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.

20 TEMPORARY AND TRIAL USAGE

20.1 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.

21 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 Column 1 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 1.34 times the TOTAL PACKAGE RATE of the current Collective Agreement. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 1.6 times the TOTAL PACKAGE RATE 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 TOTAL PACKAGE RATE . 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 built, expendable small tools, financing costs, coffee breaks, site facilities, general clean up and disposal, security, storekeeper, and all other non-productive labour.
 - (b) The Contractor is allowed a combined overhead and profit fee of 15% for work to be performed by his own forces.
 - (c) The Contractor is allowed an overhead and profit fee of 10% for work performed by a Sub-Contractor.

22 CONSULTANT REVIEWS

22.1 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.

22.2 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 .

22.3 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.

22.4 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.

23 CORRECTION AFTER COMPLETION


23.1 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.

24 ATTACHMENTS

24.1 Shop Drawing Submittal Form

- .1 Attached sample of shop drawings submittal form.



SHOP DRAWING SUBMITTAL

*Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.
Submit one submittal form per shop drawing; do not group under one submittal sheet*

Client/Architect: **[Client/Architect name]**

Project Name: **[Project name]**

Loring Project No: **[Loring Project No]**

Contractor to complete the following for each submission.

Date: _____

Contractor Name: _____ Ref No: _____

Manufacturer Name: _____

Product Type: _____

Specification Section No: _____

Contractor Trade:

<input type="checkbox"/> HVAC	<input type="checkbox"/> Plumbing	<input type="checkbox"/> Fire Protection	<input type="checkbox"/> Controls
<input type="checkbox"/> Electrical	<input type="checkbox"/> Communications	<input type="checkbox"/> Security	<input type="checkbox"/> General Trades

If this is a resubmission, check here:

Previous submission Loring reference no.: _____

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 anchor straps,
 - .6 plaster lock,
 - .7 screwdriver operated latches,
 - .8 without visible screws,
 - .9 finished prime coat only.
- .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 gasketed door where used in damp and high humidity areas.
- .5 Dish type door design to receive a tile insert where acoustic tile is applied to plaster or gypsum board ceilings.
- .6 Fire rated where installed in fire rated walls or ceilings. Fire rating to match the rating of the wall or ceiling.
- .7 With keyed cylinder locks, keyed alike, for areas subject to security risks, EG;
 - .1 public corridors,
 - .2 public washrooms,

- .3 etc.
- .8 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.
- .9 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.

4 FIRE STOPPING

4.1 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.

4.2 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.

.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.

4.3 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.
- .12 Co-ordinate installation of cast-in-place fire stopping devices with the Division responsible for the placement of concrete.

5 SPRINKLER PROTECTION

5.1 Materials

- .1 Surface panelboards, switchboards and other electrical equipment in sprinklered areas to be fitted with watertight hubs with insulated throat, for each conduit entrance.
 - Standard of Acceptance*
 - Thomas & Betts Ltd. - Series 401
 - Efcor of Canada Ltd. - Series 40-50B
- .2 Provide equipment in sprinklered areas, with hoods or shields and gasketed doors for protection against entry of sprinkler discharge, and to comply with the requirements of the electrical code, alternatively, and where indicated, provide indoor weatherproof equipment.
- .3 Ventilation openings to be overhanging drip proof type.
- .4 Indoor weatherproof equipment, where noted in the specifications and/or drawings to have CSA type 3R enclosures in accordance with the requirements of CSA Standard C22.2 No. 94.

6 EQUIPMENT SUPPORTS, AND BASES

6.1 Supports for electrical work

- .1 Equipment supplementary supports to be provided by this Division.
- .2 Work to be done by firms specializing in these fields.

6.2 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.

6.3 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 toggles.
- .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 paint.

7 GENERAL WIRING REQUIREMENTS

7.1 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.

7.2 Location of Outlets

- .1 Locate outlets in accordance with Division 01 - General Requirements.
- .2 Do not install outlets back-to-back in wall.
- .3 Where back boxes on opposite sides of a wall occupy the same stud bay, apply acoustical putty pads to the outside of the boxes.
- .4 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'), and information is given before installation.
- .5 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

7.3 Mounting Heights

- .1 Mounting height of equipment is from finished floor to centreline 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.

Description	General Area	Barrier Free
Local switches	1200 mm (47")	1050 mm (41")
Wall receptacles: General	300 mm (12")	450 mm (18")
Wall receptacles: above top of counters or counter splash backs	175 mm (7")	175 mm (7")
Wall receptacles shown above top of counters where there is no counter: height above finished floor	1200 mm (47")	1050 mm (41")
Telephone outlets	300 mm (12")	450 mm (18")
Fire alarm horns	2100 mm (83")	2100 mm (83")
Other controls	1200 mm (47")	1050 mm (41")
Panelboards	As required by code or as indicated	As required by code or as indicated

7.4 Conduit and Cable Installation

- .1 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .2 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.
- .3 Secure inserts firmly to form work before concrete is poured.
- .4 Provide insert drawings as required.

END OF SECTION

PAINTING FOR ELECTRICAL SERVICES

26 05 02

1 GENERAL

1.1 Scope

- .1 Provide industrial anti-corrosion coatings for electrical building services and related construction elements including:
 - .1 electrical services and supporting elements as specified under other sections of Divisions 26 to 28,
 - .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 26 01 01 Electrical General Requirements
- .2 26 05 01 Electrical Basic Materials and Methods

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 and structural steel support components

- .1 Indoor applications:
 - .1 top coat: single compound 100% acrylic coating,
 - .2 primer coat: as per manufacturers' recommendation for coating of steel piping,
 - .3 colour: Sherwin Williams No SW4027 (Galvano), unless specified elsewhere,
 - .4 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- ° Sherwin Williams – Pro Industrial Acrylic
- .2 Zinc rich primer applications for field painting of carbon steel material, or touch-up of galvanized steel material:

- .1 top coat: as specified for interior or exterior applications,
- .2 primer: single or multi-part zinc rich coating,
- .3 colour: gray-green,
- .4 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Zinc Clad III HS 100

3 EXECUTION

3.1 General

- .1 Refer to requirements for services to be painted in the relevant sections of Division 26 to 28 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, of 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 surfaces 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 After paint has dried, seal joints between curbs and containment floors with a silicone based industrial caulking in matching colour.

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 01 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 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).
Jacket	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 to be 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 in channel back of luminaires:
 - .1 600 volt type GTF or TEW,

- .2 temperature rating as required by CSA and/or manufacturer requirements.
- .5 Store wire and cable in a clean, dry, well ventilated area.
- .6 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.
- .7 Where white insulated wire has discoloured:
 - .1 do not install,
 - .2 dispose of the wire,
 - .3 remove and replace wire that has been installed.
- .8 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.
- .9 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.
 - .3 Aluminum Conductors: with long barrel compression sleeve connectors approved for use with aluminum conductors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.
- .10 Do not splice conductors used in parallel runs.

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 3m.
- .3 Terminate cables in accordance with Section 26 27 28 - Wire and Box Connectors - 0 - 1000 V.

3.4 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.

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 Applicable Codes and Standards

- .1 Latest edition of CSA C22.2 No 41 Grounding and Bonding Equipment.

1.4 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.

1.5 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 Conductors

- .1 Buried grounding conductors:
 - .1 bare, stranded, tinned, soft annealed copper,
 - .2 size #4/0 AWG unless indicated otherwise.
- .2 Insulated grounding and bonding conductors:
 - .1 bare, stranded, soft annealed copper,
 - .2 type RW90 green insulation.

2.2 Accessories

- .1 Accessories including but not limited to:
 - .1 grounding and bonding bushings,
 - .2 protective type clamps,
 - .3 bolted type conductor connectors,
 - .4 exothermic welded type conductor connectors,
 - .5 bonding jumpers, straps,

- .6 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 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 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.
- .8 Provide a separate bonding conductor in each conduit:
 - .1 sized as per Table 16A of the ESC,
 - .2 not less than #12 AWG copper,
 - .3 with one bond conductor for every three line conductors.
- .9 Bond building structural steel and metal siding to ground by welding copper to steel.
- .10 Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections.
- .11 Install grounding conductors outside electrical rooms and electrical closets in PVC conduit and conceal where possible. Where PVC conduit is not permitted use EMT and bond the EMT to the conductor at both ends.

3.2 System Grounding

- .1 Install grounding conductors in PVC conduit.

3.3 Equipment Bonding

- .1 Install insulated copper bonding connections:
 - .1 sized not less than #12 AWG and not less than indicated in Table 16A of the electrical code,
 - .2 to typical equipment including, but not necessarily limited to the following list:
 - (a) disconnect switches,
 - (b) junction and outlet boxes,
 - (c) receptacles,
 - (d) luminaires,

- (e) fire alarm device boxes,
- (f) communications systems,
- (g) 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.

3.4 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 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 PRODUCTS

2.1 Support Channels

- .1 Hot dipped galvanized steel, U shape, size 41 mm x 41 mm x 2.5 mm (1e" x 1e" 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 EI 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 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

- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 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.
- .6 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.
- .7 For surface mounting of two or more conduits use channels.
- .8 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.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 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.
- .14 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.
- .15 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.
- .16 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.
- .17 Do not use explosive drive pins in any section of work without obtaining prior written approval.

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 01 01 Electrical General Requirements.

1.2 Reference

- .1 CSA C22.2 No. 40 Junction and Pull Boxes.

2 PRODUCTS

2.1 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.

3 EXECUTION

3.1 Junction and Pull Boxes Installation

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.2 Identification

- .1 Provide equipment identification in accordance with Section 26 05 53 – Identification for Electrical Systems.

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 01 01, Electrical General Requirements and 26 05 01, Electrical Basic Materials and Methods.

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 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.
- .3 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.
- .4 Use rigid galvanized steel conduit for wiring where conduits are exposed to possible mechanical damage.

- .5 Aluminum conduits shall not be used.
- .6 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 Engineer's written permission. Terminate armoured cable, where shown, in accordance with the manufacturer's recommendations.
- .7 Flexible armoured conduit (or BX) with an integral insulated green ground wire may be used where concealed in walls for wiring to receptacles.
 - .1 The junction box interfacing the horizontal EMT conduit to the flexible conduit shall be located within 3 m (10') 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 3 m (10').
 - .2 The flexible conduit shall be neatly installed parallel or perpendicular to building lines, and independently supported from the slab structure above.
- .8 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.
- .9 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.
- .10 Where existing locations of flush mounted electrical devices (switches, receptacles, etc.) correspond to new devices shown, the existing dropdown conduit and outlet box may be re-used. Provide new devices, new coverplates, new home-run conduit and complete new wire.
- .11 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 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 Minimum permissible conduit size is 19mm (3/4"C), unless noted otherwise.

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 Insulated throat steel set screw 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.

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 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 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 Provide PVC conduit with bonding conductor as per Table 16A of Ontario Electrical Safety Code.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment
- .7 Install conduit sealing fittings in hazardous areas. Fill with compound.

- .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 Where EMT or rigid PVC is used, 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.
- .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.

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 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.

2.5 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

WIREWAYS AND AUXILIARY GUTTERS

26 05 37

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 and Section 26 05 05, Electrical Basic Materials and Methods.

1.2 Applicable Standard

- .1 Latest version of CSA C22.2 No.26 Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings and product data for each type and size of wireway.
- .2 Show installation details and support systems.

1.4 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 Wireways

- .1 CSA Type 1.
- .2 Manufactured to accommodate "lay-in" of cables without pulling.
- .3 Fabricated from code gauge sheet steel.
- .4 Cross-sectional dimensions as indicated.
- .5 Hinged covers secured with screws.
- .6 Standard knockouts on 300 mm (12") centres, unless noted otherwise.
- .7 Etching and rust inhibiting process both inside and outside.
- .8 Finish:
 - .1 Powder coat finish,
 - .2 ANSI #49 or ANSI #61 grey.

2.2 Accessories

- .1 Accessories to be of same manufacture, material and finish as the wireway.

- .2 Accessories to include:
 - .1 sweep elbows,
 - .2 vertical elbows (inside and outside),
 - .3 horizontal elbows (inside and outside),
 - .4 tees,
 - .5 crosses,
 - .6 couplings,
 - .7 reducers,
 - .8 expansion fittings,
 - .9 wall mount hanger brackets,
 - .10 panel flanges,
 - .11 end plates,
 - .12 barriers,
 - Canadian Electrical Raceways Inc.
 - Cooper B-Line
 - Hammond Manufacturing
 - Hoffman
 - Hubbell Wiegmann
 - Legrand Wiremold
 - Square D Company Canada Ltd.

3 EXECUTION

3.1 Installation

- .1 Provide wireways and accessories as shown and as required for a complete system.
- .2 Install wireways:
 - .1 in accordance with the manufacturer's recommendations,
 - .2 to accommodate "lay-in" of the wiring without requiring pulling,
 - .3 as a mechanically continuous system,
 - .4 as an electrically continuous system,
 - .5 with bonding jumpers at joints if necessary to maintain bonding continuity,
 - .6 with the hinged cover up,
 - .7 parallel or perpendicular to building lines. Where not possible, obtain instructions from the Consultant,
 - .8 using "C" brackets and/or wall brackets,
 - .9 with support on 1500mm (5') centres,
 - .10 with support on each side of an expansion fitting,
 - .11 with supports attached directly to the building structure,
- .3 Provide expansion fittings:
 - .1 Where wireway crosses a building expansion joint,

- .2 where required to accommodate thermal expansion.
- .4 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .5 File cuts smooth.
- .6 For galvanized wireways, coat cut edges with a galvanizing compound.
- .7 For painted wireways, coat cut edges with primer and finish coat, colour to match wireway.
- .8 Lay wiring into wireways.
- .9 Replace any wiring that is damaged.
- .10 Maintain the space above the wireway clear, to allow for full opening of the cover.
- .11 Maintain at least 300mm clear in front of wireway to allow access for cable installations.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

26 05 53

1 GENERAL REQUIREMENTS

1.1 Scope

- .1 Provide identification and warning signs for complete electrical systems as shown, as specified, as intended, and as otherwise required.

1.2 Shop Drawings

- .1 Submit list of nameplates with proposed wording, prior to engraving.
- .2 Submit list of labels with proposed wording, prior to printing.
- .3 Submit representative samples of nameplates, labels and warning signs.

2 PRODUCTS

2.1 Equipment Identification

- .1 Nameplates for panels and equipment:
 - .1 3 mm ($\frac{1}{8}$ ") thick laminated plastic plates,
 - .2 engraved lettering,
 - (a) first line: 11 mm (7/16") high lettering,
 - (b) second line: 7mm (1/4") high lettering,
 - (c) third line: 5mm (3/16") high lettering,
 - .3 black lettering on white background,
 - .4 with bevelled edges,
 - .5 mechanically attached with self-tapping stainless steel screws.
- .2 Labels for warnings, instructions etc on panels and equipment:
 - .1 printed on white polyester background,
 - .2 7 mm ($\frac{1}{4}$ ") high letters unless specified otherwise,
 - .3 UV resistant inks,
 - .4 clear polyester over lamination,
 - .5 pressure sensitive adhesive.
 - Standard of Acceptance*
 - Brady
 - Ideal Industries
 - Safety Sign
- .3 Do not commence manufacture of nameplates and labels until wording has been reviewed by the Consultant.

2.2 Wiring Identification

- .1 Colour coded phasing tapes:
 - .1 7 mil poly vinyl chloride,

- .2 pressure sensitive adhesive,
- .3 compatible with wire insulation,
- .4 permanent colour,
- .5 electrically insulating,
- .6 UV and moisture resistant,
- .7 to CSA C22.2 No. 197

Standard of Acceptance

- 3M Scotch 35
- Electro Tape Specialties 103/103C Series

.2 Wire markers:

- .1 heat shrink,
- .2 military grade polyolefin sleeves,
- .3 permanent printed wire identification.

Standard of Acceptance

- Brady
- Panduit

3 EXECUTION

3.1 Equipment Identification

- .1 Identify electrical equipment with nameplates, directories and labels.
- .2 Nameplates:
 - .1 secure to top exterior of equipment except where indicated otherwise,
 - .2 switchboards: indicate name, voltage and ampacity,
 - .3 rear of switchboard cubicles or cells: indicate name of cell or cubicle,
 - .4 panelboards: indicate name, voltage and source of power,
 - .5 terminal cabinets: indicate name, system and voltage,
 - .6 disconnects, starters and contactors: indicate equipment being controlled and voltage,
 - .7 transformers: indicate name, capacity, primary and secondary voltages,
 - .8 pull boxes and junction boxes: indicate system, circuit numbers and voltage,
 - .9 cabinets for low voltage systems, such as signals and communications: indicate name and system,
 - .10 equipment not listed above, such as, instruments, fire alarm, clock and program equipment and control panels: identify in a similar manner showing name and number of the equipment, voltage and load information.
 - .11 typical identification standards:
 - (a) Lighting, Receptacle and Power Panels: each identified with an engraved lamicoïd nameplate secured to top interior trim as follows:

LP-4NW-1EA	11 mm (7/16") high lettering
120/208 volts	7 mm (1/4") high lettering

Fed from PP-SBSW-EAA	5 mm (3/16") high lettering
----------------------	-----------------------------

.3 Directories:

- .1 Supply each panelboard with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard Name	LP-4NW-1EA
Panel Voltage	120/208 Volts
Circuit Number	Description
1	Lighting Room #34
2	Receptacles Room #34
3	Ice Machine Room #17

- .2 Cabinets for low voltage systems, such as signals and communications: as for panelboards with a directory showing circuit numbers and room locations plus a blank column for "Remarks".
.3 Cover directory list with a 0.8mm (1/32") minimum thick clear plastic sheet to protect it.

.4 Pull Boxes and Junction Boxes

- .1 Identify feeder pull boxes and junction boxes:
- (a) lettering stamped on brass or aluminum tags,
 - (b) showing the name of the feeder or system,
 - (c) voltage involved,
 - (d) data for both termination points whether equipment or panel,
 - (e) secure tag under box lid screws using steel wire.

3.2 Service Rough-in Identification

- .1 Apply a small dab of paint to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	Fire Alarm System and Emergency Voice Communication System
Dark Blue	Intercom and Public Address
Dark Green	Telephone and Data Systems
Black	Annunciator and Buzzer System
Grey	Clock System
White	Central Dictation
Orange	Nurse Call
Yellow	Alarm Systems
Pink	Computer Systems
Light Green	TV Systems

- .2 Junction boxes in furred ceilings to have colour identification on both inside and outside.
- .3 As an alternative to applying paint dabs, prepainted conduit/EMT may be used where applicable.
- .4 Colour coding is not required for lighting and power circuits.

3.3 Wiring Identification

- .1 Identify feeders and branch circuit wiring with wire markers;
 - .1 at each end of run,
 - .2 in each junction box,
 - .3 wherever they are introduced into ducts or equipment.
- .2 Identify incoming utility service lines by Red - Phase "A", Black - Phase "B", Blue - Phase "C", with colour coded phasing tape.
- .3 Band buswork in each;
 - .1 switchboard,
 - .2 unit substation cubicle,
 - .3 power panel,
 - .4 lighting and receptacle panel,with colour coded phasing tape as follows:

Red	Phase A
Black	Phase B
Blue	Phase C
White	Neutral
Green	Ground

- .4 Band feeder and sub-feeder bus and conductors as above.
- .5 Maintain phase sequence and colour coding throughout.
- .6 Connections in equipment to be Phase A, B, C from left to right when viewing from front or accessible direction.
- .7 For control conductors for motors and equipment, schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings and Operation and Maintenance Data.
- .8 Use colour coded wires in communication cables, matched throughout system. Schedule and chart, marker numbers and wire colours with corresponding equipment and include with Record Drawings and Operation and Maintenance Data.

3.4 Conduit and Cable Identification

- .1 Label;

- .1 incoming service cables,
 - .2 bus ducts,
 - .3 feeder conduits/EMT,
 - .4 feeder cables,
 - .5 communications cables.
- .2 Locate labels as follows;
- .1 at every end of every conduit, duct or cable run, adjacent to item of equipment serviced,
 - .2 on each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor),
 - .3 at intervals of not more than 15 m (50') along every exposed conduit, EMT, duct or cable run exceeding 23 m (75') in length,
 - .4 at every access point on concealed conduit, EMT, duct or cable runs,
 - .5 visible from 1.5 m (5') above adjacent floor or platform.

3.1 Fire Stopping Identification

- .1 Provide a warning card adjacent to each opening exceeding 25mm (1") in diameter, indicating the following;
 - .1 a warning that the opening is protected by a fire stopping material,
 - .2 the fire stop system used, ULC or cUL,
 - .3 F rating or FT rating,
 - .4 specific fire stop product(s) used,
 - .5 name and telephone number of the contact person should any changes to the fire stopping be required.
- .2 Provide warning labels for each fire stopped penetration as follows;
 - .1 permanently attached to walls, floors, underside of slabs, adjacent to the penetration,
 - .2 on each side of the penetration,
 - .3 vinyl panel, white and red background with black lettering,
 - .4 self adhesive with permanent pressure sensitive adhesive,
 - .5 stating:

WARNING
THROUGH PENETRATION FIRESTOP SYSTEM - DO NOT DISTURB
NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE

END OF SECTION

PROJECT CLOSE-OUT ELECTRICAL 26 08 19

1 GENERAL

1.1 Scope

- .1 Provide documentation deliverables at completion of the Work.
- .2 Submit all supporting close-out documents by email to ca.toronto@loringengineers.com for review by Consultant.

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 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.
- .3 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:	<input type="checkbox"/> Reviewed <input type="checkbox"/> <u>Incomplete or deficient - resubmit</u>
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:	<input type="checkbox"/> Reviewed <input type="checkbox"/> 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.

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. 111-18 Switches.
- .2 Latest version of CSA C22.2 No. 42:10 (R2020) 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 ($\frac{1}{4}$ ") high letters unless indicated otherwise.
- .2 Receptacle mounted:
 - .1 permanently printed on white polyester background,
 - .2 7 mm ($\frac{1}{4}$ ") 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,

2.2 Occupancy Sensor

- .1 Occupancy sensors shall be dual-technology with passive infrared and ultrasonic sensing mechanism. Type to match existing on site.
- .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 integrated with existing manual override switch. Location of override switch to be verified on site.

2.3 Receptacles

- .1 Standard style.
- .2 Heavy duty industrial/specification grade.
- .3 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.
- .4 Colour coded as follows:
 - .1 Normal power: white
- .5 One manufacturer throughout the project.

Standard of Acceptance

- Pass & Seymour (Legrand)
- Hubbell
- Bryant Electric
- Cooper-Eaton Wiring Devices (Arrow Hart)
- Leviton

- .6 The receptacles listed below represent the most common configurations and are not necessarily used on this project. Refer to drawings for types used.
 - .1 Duplex receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5262	5262	5262	5262	5262

- .2 Duplex receptacle: 15 / 20 ampere, 120 volt, grounded CSA Configuration 5-20R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5362	5362	5352	5362	5362

2.4 Cover Plates

- .1 Compatible with wiring device.
- .2 Stainless steel 18-8 chrome metal alloy, Type 302, vertically brushed, 1 mm (1/32") thick cover plates for wiring devices in flush-mounted outlet boxes.
- .3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 One manufacturer throughout the project.

Standard of Acceptance

- o Pass & Seymour #93000 Series
- o Harvey Hubbell of Canada Ltd. #93000 Series
- o Bryant Electric #S600 Series
- o Leviton #84000 Series
- o Cooper #93000 Series

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.

3.2 Installation

- .1 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.

- .2 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.

3.3 Testing

- .1 Test each receptacle for correct polarity and ground continuity.

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 copper or tin plated aluminum,
 - .2 for aluminum conductors: current carrying parts of aluminum.

Standard of Acceptance

- Burndy
- IlSCO
- Thomas & Betts

- .2 Compression type pressure wire connectors:
 - .1 long barrel
 - .2 tin plated copper for copper conductors
 - .3 aluminum for aluminum 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 Murette
- 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 Connectors shall be torqued to recommended values as per Appendix D in the Electrical Safety Code, or to the manufacturer's recommendation.
- .7 Once torqued, all bolts and connectors are to be marked across nut and set screw or bolt in permanent fashion to indicate torquing is complete for future maintenance.
- .8 Remove all traces of electrical joint compound after each connection has been made.
- .9 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 Latest Version of 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 01 01, Electrical General Requirements.

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 26 01 01 Electrical General Requirements.
- .2 Nameplates shall be in accordance with Article "Equipment Identification".

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 01 01 Electrical General Requirements.

1.6 Maintenance Materials

- .1 Provide maintenance materials as required and as specified in Section 26 01 01 Electrical General Requirements.

1.7 Operating and Maintenance Instructions

- .1 Provide operating and maintenance instructions as specified in Section 26 01 01 Electrical General Requirements.

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 Interrupting rating at 120/208 volts to match existing breakers in panel.

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 Features

- .1 Include
 - .1 on-off locking device
 - .2 handle mechanism

3 EXECUTION

3.1 Installation

- .1 Install circuit breakers as indicated.

END OF SECTION

LIGHTING 26 51 13

1 GENERAL

1.1 General Requirements

- .1 Conform with the requirements of Section 26 01 01 Electrical General Requirements.
- .2 Conform with requirements of Section 26 05 01 Electrical Basic Materials and Methods.

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.

2 PRODUCTS

2.1 General

- .1 Provide new lamps for relocated luminaires type to match existing on site. Replace faulty ballasts.

2.2 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 voltage and type to match existing exit signs on site.
- .10 With internal battery backup using sealed nickel cadmium batteries of sufficient capacity to power the sign for not less than 2 hours.

3 EXECUTION

3.1 Installation

- .1 Relocate and install luminaires as indicated.

- .2 Verify quantity of luminaires before placing orders.
- .3 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.
- .4 Co-operate with other trades to ensure proper installation of lighting luminaires.
- .5 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.
- .6 Mount luminaires perfectly level or plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling.
- .7 Take down any improperly installed luminaires and re-install without expense to Owner.
- .8 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on 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.
- .9 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.
- .10 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan co-operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown
- .11 All luminaires mounted in or on ceilings shall be supported independently of ceiling by means of chains.
- .12 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.
- .13 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.

3.3 Exit Signs

- .1 Connect Exit signs to existing circuit and provide a lock on device on the branch circuit breaker if none exists.
- .2 Connect DC circuit to the emergency power input if applicable.

3.4 Luminaire List

.1 Luminaire manufacturers are listed in alphabetical order and not in order of preference.

Title	Description	Lamp Schedule
	<p>L.E.D. exit sign complete with extruded aluminum body and faceplate in oyster finish.</p> <p>With faces as indicated on drawings.</p> <p>Surface mounted complete with universal mounting bracket for wall.</p> <p>Voltage: Verify existing on site.</p> <p>Manufacturers:</p> <p>AimLite "RPALW Series" Beghelli"Quadra RM Series" Emergi-Lite "EA Series" Lumacel "LA Series" Stanpro "RMXL Series" Dual-Lite, Ready-Lite, Uniglo equivalent (subject to approval)</p>	-

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 29 Hangers and Supports for Communication Systems
- .3 27 05 33 Conduits and Back Boxes for Communication Systems
- .4 27 05 53 Identification for Communication Systems
- .5 27 15 55 Testing for Communication Services
- .6 27 15 01 19 Data Communications Horizontal Cabling
- .7 27 15 43 Communication Faceplates and Connectors
- .8 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 balanced unshielded twisted pair 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:
- .2 Horizontal Cabling: always consult with the UTM IT contact before procuring materials. Cabling in existing installations may follow legacy standards. New installations will follow Cat 6A standards, including faceplates, Keystone jacks, patch cords, patch panels, etc.
- .3 Testing of all horizontal voice and data cabling.

- .4 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 cabling system.
- .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: $500 \text{ drops} \times 7 \text{ minutes per drop} = 3,500 \text{ minutes} = 58.33 \text{ hours}$; $58.33 / 7.25 \text{ working hours per day} \approx 8.04 \text{ days}$.
- .11 Contractor to provide a finalized network drawing reflecting 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, 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 or 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-to-end 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.
- .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 electrical 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 copper or fibre cable with connectors on each end to be used to join telecommunications circuits/links at the cross-connects. Copper cables will usually, but not always, be of Cat 6A grade. The UTM IT contact must be consulted before materials are procured.
- .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

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
- .3 27 05 33 Conduits and Back Boxes for Communication Systems
- .4 27 05 53 Identification for Communication Services
- .5 27 05 55 Testing for Communication Services
- .6 27 15 01 19 Data Communications Horizontal Cabling
- .7 27 15 43 Communication Faceplates and Connectors
- .8 27 16 19 Communication Patch Cords and Cross Connect Wire

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 Shall be similar to the one pictured below



- .2 Suitable for use in air handling spaces.
- .3 Allow for attachment to ceilings, beams, walls, threaded rods and underfloor supports.
- .4 Support a minimum cable capacity of 210 Cat 6A.
- .5 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 Cat 6A 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 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 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

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
- .3 27 05 29 Hangers and Supports for Communication Systems
- .4 27 05 53 Identification for Communication Services
- .5 27 05 55 Testing for Communication Services
- .6 27 15 01 19 Data Communications Horizontal Cabling
- .7 27 15 43 Communication Faceplates and Connectors
- .8 27 16 19 Communication Patch Cords and Cross Connect Wire

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 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 are 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 UTP cables (.288OD) in various conduit sizes.

Conduit outside diameter = C_{od}

Conduit wall thickness = C_{wt}

UTP cable outside diameter = U_{od}

$$(a) \quad ((C_{od} - C_{wt} * 2)^2) * \Pi * 0.1$$

$$(b) \quad (\Pi * (U_{od})^2) / 4$$

$$(c) \quad \text{TRUNC } (a/b)$$

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 be 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:

<i>CLEARANCE TABLE</i>	
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

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
- .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 55 Testing for Communication Services
- .7 27 15 01 19 Data Communications Horizontal Cabling
- .8 27 15 43 Communication Faceplates and Connectors
- .9 27 16 19 Communication Patch Cords and Cross Connect Wire

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 Handwritten labels are not permitted.
- .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 Cat 6A 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 Example: **12-STRAND SM DV2045A to IB073.**

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). Full bandwidth, graphical results of all tests must be provided for all cables.
- .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.

Tender

- .4 The contractor shall field test all four pairs of communications data UTP cable runs using the Permanent Link testing method. Cable test results for newly installed cables must surpass the accepted ANSI/TIA-1152 Level III and ANSI/TIA-568-C.2 standards parameters, in that cables with Marginal Passes are deemed unsatisfactory and must be repaired prior to system acceptance. Work done on existing cables, due to moves or changes, whose results are Marginal Passes must be brought up to the IT contact's attention prior to system acceptance.
- .5 Acceptable testers are as follows:
 - .1 Fluke DSX 5000 or equivalent.
 - .2 Fluke DSX 8000 or equivalent.
- .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, calibrated within one year of testing date, and in accordance to ANSI/EIA/TIA-1152 standard.
- .9 Ensure all launch testing cables and connectors are within the parameters set by the manufacturer for the number of insertions for copper.
- .10 The technicians must be able to provide successful completion documents for one of the approved tester training courses upon request.

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
- .3 27 05 29 Hangers and Supports for Communications 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 05 55 Testing for Communication Services
- .8 27 15 43 Communication Faceplates and Connectors
- .9 27 16 19 Communication Patch Cords and Cross Connect Wire

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 Cat 6A cabling as specified by the TIA/EIA-568-C.2 Telecommunication Cabling 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 Data cabling shall be 4-pair balanced twisted pair Cat 6A UTP, plenum rated (CMP) cables for all cabling projects
- .2 The horizontal Cat 6A data cable jackets shall be blue in colour, and its hue shall be as close as possible to colour code #0000FF.
- .3 The cable conductors shall be 23 AWG solid copper.
- .4 The outside diameter (OD) shall be no greater than 6.73mm (0.265").
- .5 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
Keystone Style T568A/B, Blue	Workstation Data Cabling
Keystone Style T568A/B, Colour to be determined by the UTM IT contact	Voice Cabling
Keystone Style T568A/B, Yellow	Security Cabling
Keystone Style T568A/B, Orange	Wireless Access Point Data Cabling
Keystone 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
- .3 27 05 29 Hangers and Supports for Communications Systems
- .4 27 05 33 Conduits and Back Boxes for Communication Systems
- .5 27 05 53 Identification for Communication Systems
- .6 27 05 55 Testing for Communication Services
- .7 27 15 01 19 Data Communications Horizontal Cabling
- .8 27 16 19 Communication Patch Cords and Cross Connect Wire

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 Colour details for 8P8C modular connector jacks are found in section 27 15 01 19 – 3.1.18.

2.2 Faceplates

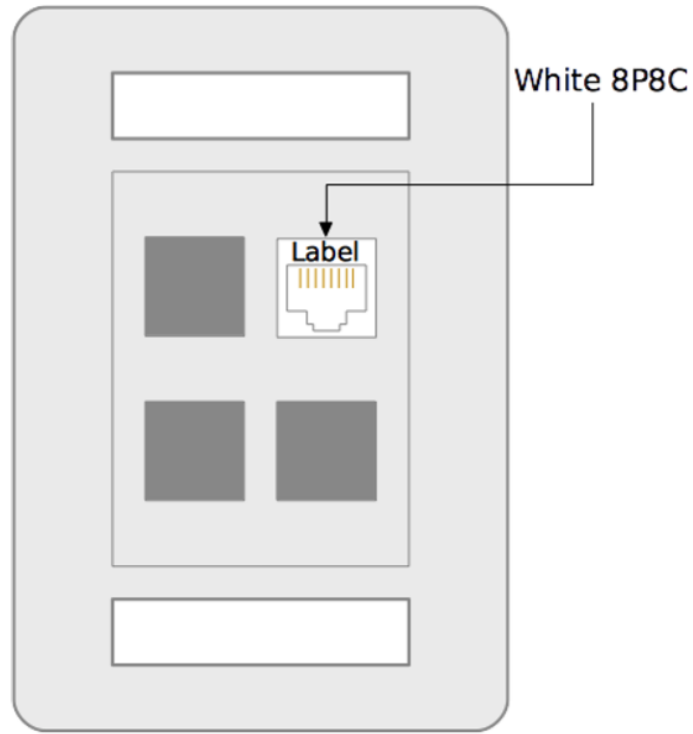
- .1 Available in 2, 4 and 6 port configurations for greater workstation outer density.
- .2 Faceplates shall be available in multiple colours to match any suit décor.
- .3 Faceplates are compatible for Cat 6A 8P8C modular connector (Keystone).
- .4 Space to facilitate outlet labelling identification 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

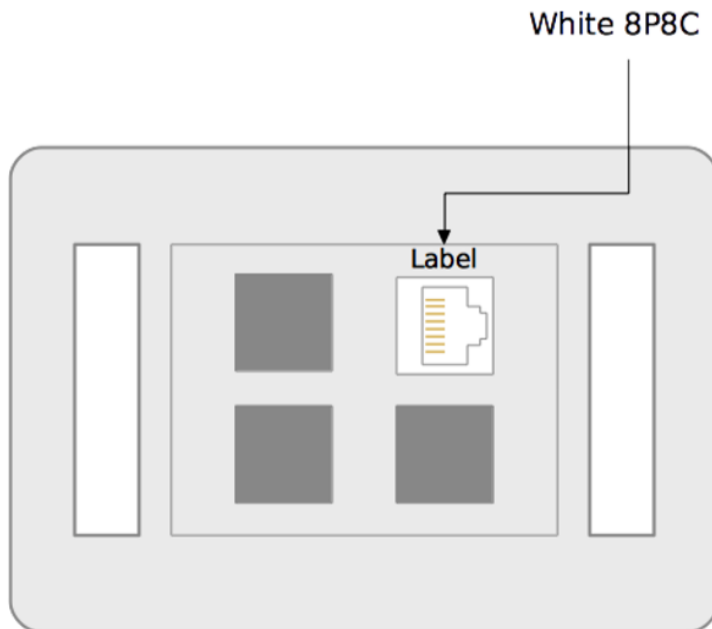
3.1 Voice Connector Termination

- .1 At the workstation faceplate terminate each voice cable on an 8P8C modular connector jack wired TIA/EIA-568A ISDN standard.
- .2 For all voice locations there shall be one Cat 6A voice cable terminated at each end as per this document.
- .3 The voice 8P8C modular connector jack shall occupy the far-right position of the 4-port 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-portfaceplate shall be installed in an 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/Keystone 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/ Keystone 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. Labels obscured from view will not be accepted and will be replaced by the contractor at no cost to the client



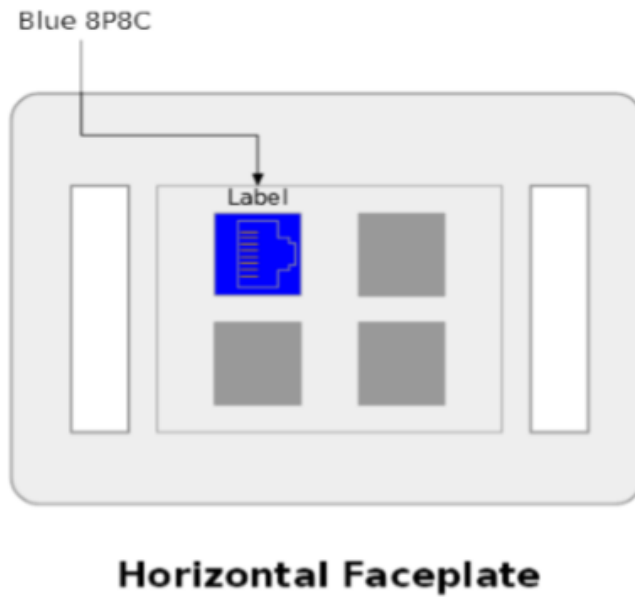
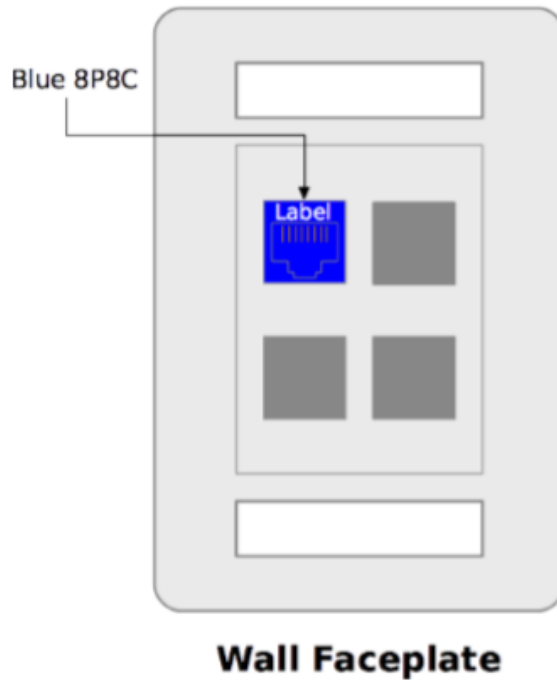
Wall Faceplate



Horizontal Faceplate

3.2 Data Connector Termination

- .1 At the workstation faceplate terminate each data cable on a blue 8P8C modular connector Keystone 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 faceplate (top to bottom).
- .3 Use blanks for all unused ports. Blanks to match faceplate colour.
- .4 Where communications are 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 faceplate shall be installed in an 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/Keystone 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/Keystone 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 replaced 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. 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



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
- .3 27 05 29 Hangers and Supports for Communications Systems
- .4 27 05 33 Conduits and Back Boxes for Communication Systems
- .5 27 05 53 Identification for Communication Systems
- .6 27 05 55 Testing for Communication Services
- .7 27 15 01 19 Data Communications Horizontal Cabling
- .8 27 15 43 Communication Faceplates and Connectors

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 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 28 AWG small diameter solid copper conductors.
- .3 The nominal cable diameter of the cordage shall be no greater than 4.72 mm (0.186 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.
- .5 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 Cat 6A 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 Cat 6A UTP patch cord for the workstation and connect it to the data jack on the faceplate. One per data drop installed.

END OF SECTION

FIRE ALARM SYSTEM RETROFIT 28 31 13

1 GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Materials and installation for fire alarm systems.
 - .2 Audible signal devices.
 - .3 Visual alarm signal devices.
 - .4 End-of-line devices.
 - .5 Sustainable requirements for construction and verification.

1.2 Related Sections

- .1 Section 26 01 01 – Electrical General Requirements
- .2 Section 26 05 01 – Electrical Basic Materials and Methods
- .3 Section 26 05 02 – Paint for Electrical Services
- .4 Section 26 05 32 – Splitters, Junction and Pull Boxes, Cabinets
- .5 Section 26 05 33 – Conduits, Fastenings and Fittings
- .6 Section 26 05 35 – Outlet Boxes, Conduit Boxes and Fittings
- .7 Section 26 08 19 – Project Close-Out Electrical
- .8 Section 26 27 28 – Wire and Box Connectors 0-1000 V

1.3 References

- .1 Government of Canada
 - .1 TB OSH Chapter 3-03, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.
 - .2 TB OSH Chapter 3-04, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Government of the Province of Ontario
 - .1 Ontario Building Code (O.Reg. 332/12, latest edition, including all amendments and references)
 - .2 Ontario Electrical Safety Code (CSA C22.1-18, latest edition, including all bulletins and references)
 - .3 Ontario Fire Code (O.Reg. 213/07, latest edition, including all amendments and references)

- .4 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524-14-AMD1, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525-16, Audible Signal Device for Fire Alarm Systems.
 - .3 CAN/ULC-S526-16, Visual Signal Devices for Fire Alarm Systems.
 - .4 CAN/ULC-S527-11-AMD1, Control Units.
 - .5 CAN/ULC-S528-14, Manual Pull Stations for Fire Alarm Systems.
 - .6 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S530-M91-R2018, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S531-14, Standard for Smoke Alarms.
 - .9 CAN/ULC-S536-13, Standard for Inspection and Testing of Fire Alarm Systems
 - .10 CAN/ULC-S537-13, Standard for Verification of Fire Alarm Systems
 - .11 CAN/ULC-S553-14, Installation of Smoke Alarms
- .5 National Fire Protection Agency
 - .1 NFPA-70-2020, National Electrical Code
 - .2 NFPA 72-2019, National Fire Alarm Code.
 - .3 NFPA 90A-2018, Installation of Air Conditioning and Ventilating Systems.

1.4 Action and Informational Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 26 01 01.
 - .2 Submit electronic copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 26 01 01.
 - (a) Shop drawings: stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Quality assurance submittals: submit following in accordance with Section 26 01 01.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Closeout Submittals:
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 05 – Project Close-out in accordance with ANSI/NFPA 20.
 - (a) Engineer will delegate authority for review and approval of submittals required by this Section.
 - .2 Submit to Engineer electronic set of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.

- .5 Include:
 - .1 Technical data - illustrated parts lists with parts catalogue numbers.
 - .2 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .3 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.
 - .4 Name, address, and telephone number of service representative of manufacturer to be contacted during warranty period.

- .6 Submit the following for review by the Consultant:
 - .1 Manufacturer's data for:
 - (a) Alarm speakers.
 - (b) Visible appliances / strobes.
 - (c) End-of-line devices if applicable
 - .2 Mark data which describe more than one type of item to indicate which type will be provided.
 - .3 Submit electronic original for each item and clear, legible, first-generation photocopies for remainder of specified copies for O&M manual.
 - .4 Schedules:
 - (a) Conductor wire marker schedule.
 - .5 Test Reports:
 - (a) Preliminary testing:
 - .6 Final acceptance testing.
 - (a) Submit for inspections and tests specified under Field Quality Control.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire alarm system installations approved and/or certified by manufacturer. Use base building fire alarm contractor if applicable.
 - .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

- .2 System:
 - .1 To TB OSH Chapter 3-04.
 - .2 Subject to Fire Commissioner of Canada (FC) approval.
 - .3 Subject to FC inspection for final acceptance.
 - .4 To Ontario Fire Marshal approval.

- .3 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 05 – Project Close-out.
 - .2 Include:
 - (a) spare glass rods for manual pull box stations if applicable.

- .4 Maintenance Service:

- .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Engineer.

1.6 Delivery, Storage, and Handling

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 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 fire alarm systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.
- .2 Modify existing system to supply a complete and operating 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.

1.8 Scope of Work

- .1 Modify existing fire alarm detection system as indicated on the drawings. Provide new equipment and devices as indicated on the drawings to form a complete and functional fire alarm system.
- .2 At the completion of the Contract, the complex shall be left with a complete fire alarm and voice communication system accepted by the Local Authorities and meeting all applicable codes.

1.9 System Operation

- .1 Modify existing circuits from control panel to each zone of initiating devices as required and indicated on the drawings. Avoid, wherever possible, transmission of signals from more than one zone over common circuit.
- .2 Existing sequence of operation to be maintained.

2 PRODUCTS

2.1 Materials

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Audible signal devices: to CAN/ULC-S525.
- .3 Visual signal devices: to CAN/ULC-S526.

2.2 Audible Signal Devices

- .1 Audible device(s):
 - .1 Fire alarm horn/strobe combination type to match existing.
- .2 Do not exceed 80 percent of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.

- .3 Finish appliances in white enamel.
- .4 For surface mounting provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

2.3 Visual Alarm Signal Devices

- .1 Surface or flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits, as indicated on Contract Drawings.
- .2 Appliances: minimum of 15 candela measured as approved by ULC, but not less than effective intensity required by Ontario Building Code for appliance spacing and location.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.
- .4 Provide visible appliances integral to audible appliances in all locations where shown

2.4 End-Of-Line Devices

- .1 End-of-line devices to control supervisory current in signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.5 Wiring

- .1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.
- .2 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor
- .3 Wire for connection to base telegraphic alarm loop: No. 10 AWG minimum solid copper conductor.
- .4 Insulation 90 degrees C minimum with nylon jacket.
- .5 Colour code wiring.

2.6 Materials

- .1 Fire alarm systems and components shall match existing base building equipment manufacturer.

3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

- .1 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 Locate and install horns and visual signal devices and connect to signaling circuits.

- .3 Connect signaling circuits to main control panel.
- .4 Install end-of-line devices at end of Class B signaling circuits.
- .5 Wire alarm output and signal devices to local DGP's as indicated on drawings, or as required to meet Ontario Building Code.
- .6 Provide line isolators in all locations where required by CAN/ULC-S524 and Ontario Building Code.
- .7 Install wiring for the alarm signal, alarm initiating, fire fighter's telephone and speaker circuits in separate raceways.
- .8 Wire signal circuits alternatively such that no two adjacent signal devices are on the same circuit.
- .9 Synchronize the flashing of any visual signaling devices (e.g. strobes) where multiple devices are visible from a single location.
- .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.

3.3 Wiring

- .1 Install wiring in conduit using wire size and type in accordance with manufacturer's recommendations, but in no cases smaller than specified herein.
- .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.

3.4 Horn Zoning

- .1 Zoning for horns shall be provided as shown on Drawings, with adjacent speakers connected to separate circuits. A minimum of two circuits per zone shall be provided. Modify existing zoning as required to accommodate new and relocated devices.
- .2 All speaker wiring shall be continuously supervised. Include circuitry in the control equipment to maintain supervision of wiring.

3.5 Field Quality Control

- .1 Site Tests:
 - .1 Fire alarm system:
 - (a) Class A circuits.
 - Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - (b) Class B circuits.
 - Test each conductor on circuits for capability of providing alarm signal online side of single open-circuit fault condition imposed at electrically most remote device on circuit.

Reset control unit after each alarm function and correct imposed fault after completion of each test.

- Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

(c) Verify audibility of fire alarm system in all occupied areas to ensure compliance with Ontario Building Code.

- Measure ambient noise sound pressure level in A-weighted decibels (dBA).
- Measure sound pressure level during alarm in dBA.
- Confirm alarm SPL is a minimum of 10 dBA higher than ambient noise, and no higher than 100 dBA in any location.

.2 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 System Verification

- .1 Changes to the fire alarm system shall be verified in accordance to CAN/ULC-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, strobes, smoke detectors, annunciators, and voice communications to ensure the following:
 - .1 That the system is complete in accordance with Contract Drawings and Specifications.
 - .2 That the system is connected in accordance with Manufacturer's recommendations and requirements.
 - .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 horns 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 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.

3.7 Cleaning

- .1 Proceed in accordance with Section 26 01 01 – Electrical General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.8 Warranty for Equipment and Installation

- .1 Provide a two (2) year full warranty for service and installation of the system modifications 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.

END OF SECTION